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WE GUARANTEE, that of this issue more than 9,200 copies were printed; that of those more than 9,200 copies, 7,048 were mailed to regular paid subscribers; 200 were provided for counter and news companies' sales; and 1,700 were printed for distribution at Atlantic City and for use as sample copies.

THE recommendation of the committee on Specifications for Cast Steel Locomotive Frames, that the maximum phosphorus and sulphur content be reduced from .06 to .05 per cent. is in accordance with the best recent practice, which is based on the experience of the majority of steel manufacturers; and the specifications as a whole should tend to the production of a better quality of cast steel frames, with a resultant decrease in the number of breakages. While the adoption of the report as recommended practice will give opportunity for improving the specifications before adopting them as standard. Should any weak point develop, the lack of discussion on the report would seem to indicate a general concurrence in the findings of the committee.

TO those who carefully listened to the address of the president on Wednesday morning and agreed with his suggestions, the report of the committee on subjects must have been a decided disappointment. Mr. Crawford said:

"From my experience with the work of the association I cannot but agree, that entirely too much attention is devoted to material and consideration of the locomotive as a mechanical device, rather than as an instrument of transportation. The study of the general proportions, the hauling capacity, the adaptability of machine to specific work, obtaining the maximum output with minimum expense is of far more importance to the railways, and to the public, than the study of the smaller details of the machine and the minute variations in the composition of the materials used in its construction."

In the recommendations of the committee for subjects to be taken up by special committees, there are but two of the ten that can in any way be considered as coming within this classification. But one of the three subjects for individual papers is of the desired grade and none of the topical discussions. The executive committee should carefully consider the president's suggestions in making the final selection of subjects.

PLAINLY, President Crawford has little respect for some statistics and some statisticians. What conclusions your statistics lead you to depends entirely on the premises you start with and the bases on which you make them. Mr. Crawford is quite justified in insisting on more care and judgment in selecting the premises and bases. Just the same, statistics play a mighty useful part in railway operation. This is especially true in the United States, where the use of statistics for operating purposes has been developed to a high degree. Except in the case of the Northeastern no officer of an English railway can tell how many tons he is hauling on an average per car or per train, simply because ton mileage statistics are not kept. However defective are the statistics kept in this country, the American railway officer can come near as any to telling how much service he is getting out of his equipment. But there is still room for a lot of improvement.

THE advisability of discontinuing the committee on Main and Side Rods may be questioned, as there still seem to be features that require further study and investigation. The committee has restricted its report to the consideration of the rods, but there is a field for investigation regarding the proper design of crank and wrist pins, especially on large power. Special designs of crank pin bearings are now in use on passenger engines and will be more common as this class of power increases in size. The question of the proper unit bearing pressure on wrist pins is also in need of further consideration. There has been a tendency toward keeping the knuckle joints too small on the heavy power. There is also a need for further investigation as to stub-ends. It has been suggested that a specification of the material to be used for rods be included with the standards, together with the allowable unit of stress. A number of roads are still not willing to adopt the high unit recommended in the report of the committee.

MR. QUEREAU'S paper and discussion on the maintenance of electrical equipment should go far to do away with the bugaboo that undoubtedly exists as to the difficulty of the work. It appears that all of the mystifying terms that are so incomprehensible to the average steam railway man, are not to be feared, and that the real work lies in the purely mechanical operations which are familiar, in a general way, to all who have had machine or repair shop experience. The New York Central, Pennsylvania and New Haven have their repair departments organized on a purely mechanical basis. Hence, it follows that others may do likewise and that the superintendent of steam motive power may look with undisturbed equanimity on any proposals to electrify a part or a whole of the lines of which he has charge so far as the maintenance of the new form of equipment is concerned.

THE exhibits are to be open this year, for the first time at Atlantic City, on Saturday afternoon and also on Monday evening. The evening exhibit is in the nature of an experiment to ascertain if the members in any considerable numbers care to spend the evening among the exhibits on the Pier. If it is found that they do, it is quite probable that in future years arrangements will be made to keep them open for two or more evenings. Since all formal evening entertainments have been left off the program this year, there is no especial attraction to take the time and interest of most of the members and guests, and it is believed that they will be glad of the opportunity to more thoroughly and comfortably examine the tools and appliances shown by the supply companies. Even though a man is in attendance during the full sessions of both associations, if he attends the meetings with fair regularity, the actual amount of time available for inspecting the exhibition is very limited when its size is considered. In past years, if a member took an hour off during each sessions and spent all of each afternoon on the Pier, he had but a total of 22 hours to see the exhibits. This year on the same basis, he will have 29 hours. As a

matter of fact this time is reduced by half by the time spent in greeting old friends, committee meetings, other attractions, etc. The regular attendants who have kept in close touch with the new developments each year will find this sufficient time, but the newer members and especially those who are here for but one convention, are compelled to forego full advantage of the opportunity which the supply companies have spent many thousands of dollars to provide. From every standpoint these exhibits are wonderful and full of educational possibilities. It would seem only fair to the men who have provided them that every opportunity be given the members to examine them to their satisfaction. When formal entertainments were provided, it was not feasible to hold evening sessions at the exhibits, but that restriction is not in force now and a chance is being given you to cast your vote for more time to study the latest developments in the motive power and car department fields. If you are in favor, come to the pier Monday evening and show your appreciation of the opportunity.

LOCOMOTIVE TESTING PLANTS.

BEYOND doubt the most valuable information contained in the proceedings of the Master Mechanics' Association is in connection with the work performed on the locomotive testing plants of the Pennsylvania Railroad and Purdue University. In several instances the conclusions reached from tests made on these testing plants have determined the policy of locomotive designers throughout the country. The tests on superheaters and front ends, in particular, have been of inestimable value. The appendix to the report of the committee on superheater locomotives, to be presented on Friday, will undoubtedly be a striking illustration of the value of these plants to the association. It is, therefore, with especial satisfaction that the members listened to Prof. Schmidt's description of the locomotive testing plant recently put in operation at the University of Illinois. This plant is considerably larger than its predecessors and will accommodate the largest size of mallets. It gives the first opportunity for accurately investigating some of the problems peculiar to this type. Furthermore, the plant, being located at a university, will be largely used in investigation of problems that are general in their nature, while the Altoona plant must of necessity be devoted for the greater part of the time to problems peculiar to the locomotives of the Pennsylvania Railroad. The Purdue plant is by its size prevented from undertaking tests on the most modern locomotives.

The Illinois testing plant differs essentially from the others, in addition to its size and capacity, only in the arrangements provided for collecting the sparks. For this purpose a somewhat elaborate equipment has been designed and installed. The loss of heat through the medium of the sparks discharged from a locomotive working at a high rate of combustion is very large, and heretofore considerable difficulty has been found in accurately determining the loss from this source. The information which will later be forthcoming will probably prove of decided value, especially in regard to fuel economy with stokers.

While tests in connection with many features of locomotive operation and design are not to be compared with the results of regular service operation, the character of most of the investigations made on a locomotive testing plant is such that they cannot be made in any other way. The findings in every case should be checked by road work under regular service conditions, but no amount of study of services can develop the basic principles and positive conclusions that can be readily obtained from test plant records. It is quite true, as President Crawford stated, that a few test runs of a stoker locomotive over a particular division and then a few with a hand fired engine over the same district are not to be compared with the comparative record of a year's service of a hundred locomotives of each kind to determine the relative coal consumption. Still a test of both kinds of firing on a locomotive testing plant will develop faults in the design and construction of the machine, quality and preparation of the fuel, and the best method of operating the locomotive that could never be discovered by road work.

The value of the new test plant to the railroads of this country will eventually be beyond calculation and the University and state of Illinois are to be commended for their enterprise and progress and the Master Mechanics' Association is to be congratulated on the fact that it will obtain the benefit of much of the work done on it.

LOCOMOTIVE PROGRESS.

SINCE the last Master Mechanics' convention the progress in locomotive design has been marked by no new, "largest locomotive in the world," but it has by no means been stagnant on that account. In fact, it may finally be found that the progress has been of more far-reaching importance than during any previous equal period. Probably the most valuable work of the year is the awakening to a better appreciation of the possibilities of improved combustion and the ways of taking advantage of it. The publication of the results of the tests on fireboxes at Coatesville forcibly drew attention to the value of that end of the boiler and the opportunities it offered for increasing the capacity of the engine. This was already well understood by some designers, but a general understanding of the possible improvements at this point is but now beginning to develop.

The most striking feature of the year has been the rapid application of superheaters to all classes of locomotives. During the past year there have been over 4,400 superheaters applied in this country. This is practically as many as had been applied altogether up to May 1, 1912. The use of superheaters on switching locomotives is now becoming general, while a year ago it was distinctly experimental. Superheaters have been applied to practically all classes of road engines built during the year and to many of the older engines as they passed through the shop. Considerable progress has been made in overcoming troubles with lubrication, and in a few cases slide valves are being successfully operated with superheated steam. It appears, however, that there is yet something to be learned in connection with the operation of superheater locomotives. There is a strong tendency for some engineers to carry the water too high and thus, either carelessly or thoughtlessly, defeat the economics and reduce the capacity of the locomotive. The water level should be as low, if not lower, on superheater locomotives as on saturated steam ones, and all traveling engineers should thoroughly understand this.

The progress of the mechanical stoker during the year has been continuous, although confined to comparatively few railroads, and, so far as practical, application is concerned, to but two types. Other designs are in the experimental stage, with fair prospects of future success. The possibilities of using cheap fuel with the stoker are opening most attractive prospects in some districts.

There have been no new locomotive types developed in this country during the year, but the status of some of the older types is undergoing a change. The Pacific type is becoming quite popular for high speed freight traffic, and Mallets are being built for switching and hump-yard work in some of the larger classification yards.

There has been a noticeable refinement and improvement of many of the detail parts. New valve gears and better designed parts of the older types are being generally used on new power. The design of driving boxes has been greatly improved in some cases. Power and screw reverse gears are preferred on the larger locomotives. In one case, at least, a power reverse gear has been applied to six-wheel switch engines. New throttle lever arrangements, protected water glasses, safer squirt hose construction and attachment coal pushers in the tender, heat-treated alloy steels for parts subject to excessive strain and improved pipe brackets and similar parts are among the smaller improved features. Feed water heating seems to have made but little progress.

TO-DAY'S PROGRAM.

M. M. ASSOCIATION.

The following subjects which were on the program for Thursday could not be considered and were carried over until to-day:

Discussion of reports on:

Superheater Locomotives.

Specifications for Materials Used in Locomotive Construction.

Individual papers on:

Three-Cylinder Locomotives, by Mr. J. Snowden Bell.

The following is the scheduled program for to-day:

Discussion of Reports on:

Use of Special Alloys and Heat-treated Steel in Locomotive Construction	9.30 A. M. to 10.30 A. M.
Smoke Prevention	10.30 A. M. to 11.00 A. M.
Engine Tender Wheels	11.00 A. M. to 11.30 A. M.

Individual Paper on:

Tests of Superheater Locomotives, by Dean C. H. Benjamin	11.30 A. M. to 12.00 M.
Resolutions, Correspondence, etc.	12.00 M. to 12.15 P. M.
Unfinished Business	12.15 P. M. to 12.30 P. M.
Election of Officers, Closing Exercises	12.30 P. M. to 1.30 P. M.
Adjournment.	

ENTERTAINMENT.

Orchestra Concert 10.30 A. M.—Entrance Hall, Million Dollar Pier.

Orchestra Concert, 3.30 P. M.—Entrance Hall, Million Dollar Pier.

Musicale, 9.00 P. M.—Entrance Hall, Million Dollar Pier.

EXHIBITORS ASKED NOT TO EMPLOY PRIVATE WATCHMEN.

The executive committee of the Railway Supply Manufacturers' Association has passed a resolution asking exhibitors not to employ private watchmen for their booths. The exhibits are given ample protection in accordance with the rules of the association, under the contracts for exhibit space.

INSPECTION LOCOMOTIVE FOR THE P. & R.

S. G. Thomson, superintendent of motive power and rolling stock of the Philadelphia & Reading, advises that a new Atlantic type officers' inspection locomotive has just been completed at the Reading shops and will be on exhibition at the track exhibit, Atlantic City, for the next few days. The locomotive is said to have several unusual features of construction which will be of interest to convention attendants.

RETURN TRANSPORTATION.

Any of the members desiring transportation over the Central Railroad of New Jersey should make application to C. E. Chambers, superintendent of motive power, and the transportation will be arranged for.

LOCOMOTIVE INJECTOR IMPROVEMENTS.

The last annual report of the Department of Locomotive Boiler Inspection of the Interstate Commerce Commission indicated that certain features of the injector and its fastenings were giving difficulty and needed attention. Representatives of the locomotive builders, the manufacturers of injectors and the Locomotive Boiler Inspection Department have held two conferences, one of them taking place in Atlantic City on Wednesday afternoon. The outcome has been the appointment of a committee to investigate the proper material, form, size, etc., of the coupling of the copper pipe to the injector. The most important question to be considered will be whether the method of brazing can be improved to make it satisfactory, or whether it will have to be superseded by some form of flange connection.

FOUND.

A memorandum book and a pair of eye glasses have been found and may be claimed at Secretary Conway's office.

INFORMAL DANCE AT THE PIER.

An informal reception and dance was held last evening at the entrance hall of the Million Dollar pier. The dance attracted a large crowd of the visitors at the convention and was just informal enough to be very popular.

CHROME VANADIUM TENDER WHEELS FOR THE GRAND TRUNK.

The Grand Trunk has specified chrome vanadium steel for 400 tender wheels which it has ordered from the Standard Steel Works and the Carnegie Steel Company, the order being divided evenly between the two companies.

MOVING PICTURES OF FIREBOX TESTS.

Visitors in the main hall on the pier enjoyed a rather interesting diversion while the moving pictures were being shown Thursday morning. Pictures were thrown on the screen showing the explosion tests of the Jacobs-Shupert and radial stay boilers at Coatesville, Pa., last spring. Convention attendants may be interested in knowing that the two fireboxes which were tested are being shown in the track exhibit this year. The moving pictures of the tests will be shown several times a day during the conventions.

COMMITTEES ON OBITUARIES.

President Crawford of the Master Mechanics' Association yesterday named the following committees on obituaries:

Geo. Richards	G. W. Wildin
Amos Pilsbury	P. H. Hammett
Henry Schlacks	Angus Sinclair
Reuben Wells	J. H. Setchel
Oscar Antz	O. M. Foster
F. M. Gilbert	F. M. Whyte
William Gill	G. W. Seidel
H. B. Howe	J. W. Taylor
C. E. Gossett	G. H. Emerson
W. A. Mallay	W. H. Bennett
J. H. Murphy	J. P. McCuen
J. J. Ryan	G. McCormick
A. Forsyth	C. B. Young

MASTER MECHANICS HONOR MEMORY OF HENRY SCHLACKS.

The Master Mechanics' Association, at the meeting yesterday morning, on motion of Angus Sinclair, adopted a memorial resolution on the death of Henry Schlacks, formerly superintendent of machinery of the Denver & Rio Grande, who died in Chicago on May 16, age 73 years, the resolution is as follows:

"Resolved, that this convention expresses warmest sympathy for the widow and family of Henry Schlacks, in the irreparable loss they have sustained in the death of an ideal husband and an affectionate father, which sad event occurred on May 16 last: Also, that in the death of Henry Schlacks, this association has lost a conscientious, hard-working mem-

ber, who performed valuable services to the railroad world in promoting sound railroad engineering."

Mr. Schlacks, who retired from service in 1902, was one of the oldest members of the association. He was the father of Charles H., vice-president of the Western Pacific; Henry J., an architect in Chicago; Joseph T., vice-president of the McCord Manufacturing Company, Detroit, Mich.; William J., with McCord & Company, Chicago; Edward L., in the coal business in Nebraska, and Robert J., manufacturers' agent in Denver, Colo.

THE UNANSWERABLE QUESTION.

How many boards in the Boardwalk?
How many fish in the sea?
How many grains of sand on the beach?
Can you tell that all to me?

The information bureau man
Has an answer for them all,
His head is full of facts like that
Though his figures may be tall.

But there's one thing that stumps him,
Though he does the best he can;
That's where to go on Sunday,
For the very thirsty man.

MUSICAL EVENING.

An instrumental and vocal concert to be held at the entrance hall of the Million Dollar Pier has been arranged by the entertainment committee for this evening. F. Pincus presents Eugene Engel's orchestra in the following program:

1. Orchestra. "Rakaszy" Hungarian March.....*Liszt*
2. La Favorita Quartette.
   (*a*) Puck's Song from "Fairyland"
   (b) Come Away Elves " " *Morgan*
   Katherine Rosenkranz
   Julia Z. Robinson
   Henry Hotz
   Anthony D. McNichol
3. Orchestra. Overture Raymond .....*Thomas*
4. Trombone Solo.
   Cujus Animam, from "Stabat Mater" .....*Rossini*
   David Claffy
5. Soprano Solo.
   "One Fine Day," from "Madame Butterfly".....*Puccini*
   Elsa Meiskey
6. Orchestra. Spanish Serenade "La Paloma".....*Yeadier*
7. La Favorita Quartette. "Rigoletto" .....*Verdi*
   Katherine Rosenkranz
   Julia Z. Robinson
   Henry Hotz
   Anthony D. McNichol
8. Orchestra. Selections from Opera Traviata .....*Verdi*
9. Harp Solo. (*a*) Mazurka in B-f minor.....*Shuecker*
   (*b*) Serenade .....*Mosvkowski*
   (*c*) Raindrops .....*Alvars*
   Helen Reed Alexander
10. Orchestra. Overture "Light Cavalry" .....*Suppe*
11. Soprano Solo. "Coquette" .....*Leo Stern*
    Elsa Meiskey
12. Orchestra. Medley of familiar Home Songs
    "Rocked in the Cradle of the Deep"
    "Massa's in the Cold, Cold Ground"
    "The Old Oaken Bucket"
    "Blue Bells of Scotland"
    "My Old Kentucky Home"
    "I Cannot Sing the Old Songs"
    "Swanee River"
    "Auld Lang Syne"

BOOSTING FOR SAN FRANCISCO.

Under the leadership of A. M. Mortensen, traffic manager of the Panama-Pacific International Exposition, a bunch of Western railroad men is boosting energetically for San Francisco as the meeting place of the conventions in 1915. Among the boosters are J. F. Dunn, assistant general manager of the Oregon Short Line, Salt Lake City; F. E. Davisson, superintendent of machinery of the San Pedro, Los Angeles & Salt Lake, Los Angeles; H. J. Small, general superintendent of motive power of the Southern Pacific, San Francisco; D. P. Kellogg, superintendent of shops of the Southern Pacific, Los Angeles; I. L. Yates, of the Pacific Fruit Express, and S. L. Bean, mechanical superintendent of the Atchison, Topeka & Santa Fe Coast Lines, Los Angeles. J. F. Graham, assistant general manager of the Oregon-Washington Railroad & Navigation Company, Portland, is also expected to join the brigade of Exposition pushers when he gets on the job.

To those who are familiar with the attitude usually assumed toward one another by the cities on the Pacific Coast, the way the railway men from the rival communities are pulling together is beautiful to behold.

Pictures illustrating the attractions of the Panama Canal trip, of the exposition and of San Francisco and the Pacific Coast generally will be thrown on the screen on the pier Monday, Tuesday and Wednesday of next week, and boosting literature will be distributed.

The Exposition offers to guarantee the expense of providing a place for the Railway Supply Manufacturers' exhibit, if the conventions go to San Francisco; and the railway will make a one-way freight rate on exhibits.

RAILWAY CONSTRUCTION IN FORMOSA.—The Daito line, Formosa, was projected for the purpose of developing the eastern side of the island and is to connect Karenko and Bokusekikaku, a distance of 53 miles. The work was started in 1909 and was to be spread over 6 years. The amount appropriated for this construction was $2,128,000. That portion of the line connecting Karenko and Hozan has been completed and opened to traffic, while the remainder is still under construction.

SZECHUAN-HANKOW LINE, CHINA.—In Chengtu a public meeting has been held by the shareholders of the Szechuan-Hankow railway. The shareholders decided to utilize their funds for the construction of lines in connection with the main line. By the order of the Ministry of Communications Mr. Chang Li-ken has been despatched to institute a survey and an estimate of the railway between Shasi and Ichang; Tuan Mu and others are to construct the branch lines from Pinghsiang to Changshu-tung.

CANTON-HANKOW LINE, CHINA.—Another section of the Canton-Hankow line has been opened and it is possible to get as far as Yingtak. There was some delay and difficulty in laying this line along the pass known as the Blind Boy's Pass, because the right of way was very rocky, and there was some tunnelling to be done. But whilst work went on slowly here, farther on the line was pushed forward, so that when this difficult section was conquered, little delay was expected, and so it has turned out. Unfortunately the station at Yingtak is some distance away from the city. It appears that the west river—that is a branch of the North river, not the West river—is the cause of this. In other words, the line had to cross this river, and near the mouth, which is just opposite the city, the river was too wide to be bridged. At any rate it was found to be much easier to run the bridge across farther up the stream, and so the line was carried along some distance from the city. Reports affirm that already the line is popular. The report of the opening of this section of the line goes on to say that before the year has run its course the line will be opened all the way to the district city of Shiu Chow. Much of the track is already laid, and it remains only to link up these several sections, whereupon there will be a direct track from Canton to that district city.

MASTER MECHANICS' ASSOCIATION PROCEEDINGS.

Reports on Cast Steel Frames, Rods, Boilers, Tires, Headlights, Care of Electrical Equipment, Engine Testing Plants.

President Crawford called the meeting to order at 9.40 a. m. Thursday.

SPECIFICATIONS FOR CAST STEEL LOCOMOTIVE FRAMES.

In 1904 there was submitted to the association the following specification for cast-steel locomotive frames, as suggested by the committee of steel-casting manufacturers.

MATERIAL.

Carbon ..... .28 per cent.
Phosphorus ..... .05 per cent.
Sulphur ..... .05 per cent.
Manganese ..... .60 per cent.
Frames will be rejected that show:
Less than .20 per cent. or over .35 per cent. carbon.
Over .06 per cent. phosphorus.
Over .06 per cent. sulphur.
Over .70 per cent. manganese.
Tensile strength per square inch, not less than 55,000 lbs.
Elongation in 2-in., not less than 15 per cent.
All frames to be annealed.

The committee has found in its investigation that there is still considerable difference in opinion among railroad officers, steel manufacturers and locomotive builders in regard to the chemical and physical requirements for cast-steel locomotive frames.

CARBON.

The experience of many of our members and some of the manufacturers indicates that better results are obtained if frames are made from a .37 to .40 carbon steel instead of .25 to .28. This gives an increased stiffness and higher elastic limit. Of course, the ductility is reduced, but if the frames are properly annealed a high carbon content should give much better results on the heavy power used to-day. The tests of low carbon steel frames of recent manufacture show carbon content ranging between .24 and .30, with an average of .273. The tests of high carbon steel show carbon between .39 and .42, with an average of .405.

PHOSPHORUS AND SULPHUR.

The general consensus of opinion among all manufacturers and users is that the rejection limit of the phosphorus and sulphur content should be changed from .06 to .05. From the large amount of data available to the committee, the phosphorus content of frames of recent manufacture ranges between .037 to .048, with an average of .0443, and the sulphur content ranges between .022 and .043, with an average of .0305.

MANGANESE AND SILICON.

The manganese content in the old specification was .60, with a rejection limit of .70. It is the usual practice to-day to accept material having .70 of manganese and .20 of the silicon, but it is not the usual practice to specify limits for either of these elements in recent specifications for steel. Manganese usually ranges between .50 and .70. Silicon usually ranges between .24 and .28.

TENSILE STRENGTH.

The specification of 1904 recommends not less than 55,000 lbs. tensile strength. All specifications which have been examined call for not less than 60,000 lbs. tensile strength, many call for 65,000 lbs. while some call for 70,000 lbs. to 80,000 lbs. Many tests in the hands of the committee show tensile strength from 75,000 to 80.000 lbs., and quite a number of them run as high as 85,000 lbs.

ELONGATION.

The 1904 specifications require an elongation of not less than 15 per cent. in 2 inches. The usual practice at the present time is an elongation of 20 per cent. in 2 in. As the carbon content of steel is increased the tensile strength is increased, but the ductility is decreased, and perhaps a better rule to follow is "the per cent. of elongation in 2 in. shall not be less than 1,200,000 divided by the tensile strength." For steel of 60,000 lbs. tensile strength, this gives an elongation of 20 per cent. For steel of 75,000 lbs. tensile strength, the elongation would be 16 per cent.

ANNEALING.

The usual practice in annealing frames is to apply heat slowly, so that all castings in all parts of the furnace are heated to a uniform temperature of 1,5000 degrees, after which the furnace doors may be opened and the furnace and contents allowed to cool.

VANADIUM.

The committee has not deemed it advisable to submit a standard specification for vanadium steel frames at this time.

The following specification for cast-steel frames is recommended:

Castings must be true to pattern and free from flaws, shrinkage cracks, excessive scale or porosity. When patterns are furnished by a railroad company the manufacturer must make sure that the allowances for shrinkage in the patterns agree with his own practice, and castings will be rejected, even when made from railroad company's patterns, which do not conform closely to required dimensions. Frames must be made perfectly straight and in true alignment, both vertically and horizontally. Frames will not be accepted which weigh less than 97 per cent. of the weight specified, and material in excess of 6 per cent. above the specified weight will not be paid for. The specified weight must allow a proper amount for finish, as may be agreed on.

All castings must be thoroughly and properly annealed, and test pieces must be annealed with the castings before they are detached.

Test pieces shall be one inch square, and, when possible, 10 in. long, and must be left attached to each frame. At least two test pieces, one near each end of the frame, shall be provided. The test pieces shall be partly sawed off from the body of the casting so that they can be easily broken off, but shall not be entirely detached by the manufacturers. Both the main casting and test pieces shall be stamped with heat numbers. The finished test pieces for tensile strength test shall be ½ inch in diameter and 2 in. between shoulder fillets.

The material desired has a tensile strength of at least 70,000 lbs. per square inch; elongation, 20 per cent. in 2 in., and an elastic limit of 50 per cent. of the tensile strength.

Cast-steel frames will be rejected which show less than the following requirements:

Tensile strength, minumum.....65,000 lbs. per sq. in.
Elastic limit, minimum.....30,000 lbs. per sq. in.

Elongation in 2 in. shall not be less than a percentage represented by 1,200,000 divided by the tensile strength.

Reduction of area, minimum..... .30 per cent.
Phosphorus, maximum ..... .05 per cent.
Sulphur, maximum ..... .05 per cent.

When high carbon steel frames are specified, the carbon content must be not less than .37 per cent. and the reduction of area not less than 25 per cent.; other requirements as above.

The report is signed by:—C. B. Young (C. B. & Q.), chairman; E. W. Pratt (C. & N. W.); R. K. Reading (Penna.); O. C. Cromwell (B. & O.); C. E. Fuller (U. P.), and L. R. Pomeroy.

DISCUSSION.

G. W. Wildin, (N. Y. N. H. & H.): I move the report be referred to the association by letter ballot.

F. F. Gaines, (C. of Ga.). I second the motion. I presume Mr. Wildin means for "Recommended practice." I would suggest that before the committee send in these Specifications for Locomotive Frames for letter ballot, that they carry out their suggestions in the last paragraph about high carbon content, and include that, as well as the suggestion about the elastic limit and tensile strength, and that they be placed in parallel columns in the final specifications.

(The motion was carried.)

INDIVIDUAL PAPER ON MAINTENANCE OF ELECTRIC EQUIPMENT.

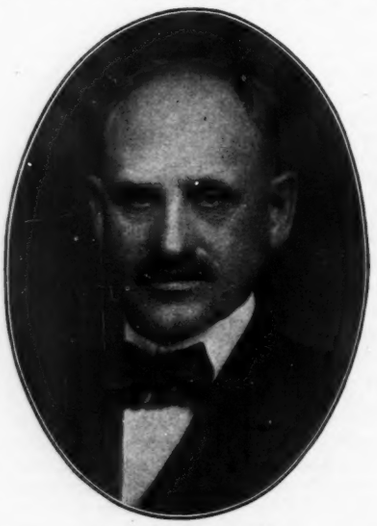
By C. H. Quereau.

We all recognize the fact that several important steam railroads, have, to a limited extent, replaced steam locomotives with electric locomotives and multiple-unit cars; and that their successful operation for five or six years and the experience gained during this time makes the subject of the maintenance of electric equipment a live one. The fact that at least six American steam railroads are now using electricity for motive power purposes and the recent announcements of plans for extensive electrification of main lines on western steam railroads suggest the thought that almost any steam motive power organization may be called upon at an early date to maintain electric

motive power and should make this subject of interest to all steam motive power men.

The word electricity naturally raises in the mind of a steam motive power man a suggestion of mystery, something he knows little or nothing about, and, what is worse, he is very apt to conclude he is "too old to learn." It is the object of this paper to try to show there is no more mystery about electricity than about water, steam, coal or other gifts of nature about which motive power men have enough knowledge and familiarity to successfully manage their work; if possible, to remove the natural, but useless, fear of the subject which most of us have.

To those acquainted with the men who are responsible for the maintenance of electric equipment—whether on trolley, interurban or steam railroad lines—it is a matter of common knowledge that those Master Mechanics, General Foremen and Mechanics who have been trained in the Motive Power Departments of steam railroads have somewhat the advantage of those who have not. I have in mind a western mechanic and general foreman whose experience with electric equipment was limited to six months as electric inspectors' helpers, who are eminently successful in maintaining electric equipment. In the case of steam railroads which are electrified, there are decided advantages in using men already in the organization whose characteristics are known, who are familiar with steam railroad policy, methods and requirements and such a plan removes all ground for the possible feeling that electrification will crowd out of their positions men who have served the railroads faithfully and satisfactorily for years. Some knowledge of electricity for such men is certainly necessary, but it is very elementary and simple, preferably practical rather than theoretical, and can be acquired in



C. H. QUEREAU,
Paper on Maintenance of Electric Equipment.

such a short time that the advantages of using men for the maintenance of electric equipment who are already in the steam motive power department very decidedly outweigh the disadvantages due to lack of an extended knowledge of electrical apparatus. This conclusion has been reached after six years' experience in an electric equipment maintenance department on a steam railroad.

I am inclined to believe the greatest bugaboo for the steam motive power man, when considering electrical matters, is the fact that he is not familiar with electrical terms and therefore imagines the whole subject is difficult. When the uninitiated hears or reads of volts, amperes, watts and kilowatts, circuit breakers, contactors and other electrical terms, he finds these words as meaningless as so much Choctaw. As a consequence, he gets no real information or adequate conception of the subject discussed and, perhaps naturally, concludes it must be beyond his powers and altogether mysterious. A little reflection will show him that at one time he was equally ignorant about such commonplace matters as hydrostatic pressure, steam consumption, horsepower, airbrakes and superheaters, and that in all probability it would puzzle him, after years of practical use, to accurately define these terms, or even explain to a visitor from Mars what a foot really is, though for all practical purposes he knows each of them thoroughly and never imagines his inability to define technically the words he uses almost hourly is any handicap in successfully holding his job.

I have previously stated that "Some knowledge of electricity . . . is certainly necessary, but is very elementary and simple, preferably practical rather than theoretical." In this connection it should not be forgotten that this paper relates to the maintenance and is not concerned with the design of electric equipment. Experience has shown that the graduate in an electrical course who is employed in maintaining electric apparatus is apt to require wiring diagrams and blue-prints showing the circuits and relations of the apparatus, while the inspector whose training has been wholly practical soon learns by precept and practice that a given symptom is caused by a given defect and does not find it necessary to trace the intermediate steps, but goes at once to the seat of the trouble and removes the cause. For instance, when an electric locomotive loses power when the motors are operated in series parallel, after having operated satisfactorily in series, the embryo electrical engineer is prone to waste time in hunting up wiring diagrams and tracing circuits, while the inspector whose knowledge has been acquired by practical experience knows that either a certain fuse has blown because of an overload, or a certain contactor has failed to operate properly and at once applies the necessary remedy.

It would be unwise to assume from the foregoing that an elementary knowledge of electricity and the ability to read wiring diagram blue-prints are undesirable or unnecessary to anyone employed in the maintenance of electric equipment. Such knowledge is both desirable and necessary, just as much as for steam equipment, but no more. The point is that the average mechanic, without previous electrical experience, does not require any great amount of electrical knowledge in order to successfully compete with an electrician in maintaining electric motive power.

The most helpful illustration to an understanding of electric circuits and diagrams is to think of them as showing a water system. In place of the electric motor put a water motor, and consider the wiring plans as showing the distribution and connections of water pipes. The analogy can be carried farther; the water pressure stands for the voltage and the pounds or gallons of water flowing or available, the amperage of electric current; the horse-power hours of a water turbine are the equivalent of the kilowatt-hours or horse-power hours of an electric motor or generator.

If simple and inexpensive precautions are taken, there is no greater danger in working about electric than steam equipment. No one with ordinary sense and experience would think of putting his bare hand on the unprotected steam pipe of an injector, even though he cannot see the steam flowing through it. There is no greater danger in connection with electric circuits if the same common sense is used. This refers to 600-volt direct current and would possibly have to be modified for materially higher voltages, not to high-tension lines, where the hazard is undoubtedly greater.

The statement is occasionally made that an electric is a simpler machine than a steam locomotive. If this refers to ease of handling and operating or matters requiring the attention of the engine crew, such as injectors, steam pressure and water level, there is no possible doubt the statement is correct, but if it refers to the mechanical simplicity or number of adjustable or moving parts that must be inspected and kept in proper relation, the steam locomotive is very much the simpler. There is, however, this fundamental difference favoring the electric machine: that the moving parts of the control are of very light weight, easily accessible for inspection and repairs and not subjected to nearly as great wear as are the corresponding parts of a steam locomotive.

It will no doubt interest motive power men to know that the shop arrangement and tools for maintaining electric equipment are not essentially different from those they are accustomed to in repairing steam locomotives, except, of course, the electric locomotive has no boiler or tender and it is necessary to provide facilities for rewinding armatures and field coils.

The steam motive power man will no doubt be much surprised when told the electric locomotive requires no shopping for a general overhauling, except for a general painting. This is made possible by having a stock of spare parts, permitting the removal of a defective part from a locomotive, the substitution of a repaired part and releasing the engine, the defective apparatus being repaired at leisure. For instance, a set of driving wheels needing tire turning are replaced by an extra set in good condition, this operation requiring not more than five hours with adequate drop pit facilities. Air compressors, controllers and contactors can be handled in the same way.

The steam locomotive can not be maintained on this plan, as the boring of cylinders and resetting flues make it necessary to shop the engine, withdrawing it from service for a considerable length of time.

It is quite possible the foregoing statements of personal experience and opinions will not prove as convincing as the records made by an electric equipment maintenance department organized by and largely consisting of men whose earlier experience and training were obtained in the motive power department of steam railroads. It seems reasonable common sense will conclude there can be no particular mystery or unusual danger in maintaining electric locomotives when the records for the year 1912, after five years' service, show a cost of less

than 4 cents per mile and an average of 48,271 miles per train detention due to electrical apparatus, with a banner record of 249,423 miles (equivalent to ten times around the world), without a train detention due to the electrical equipment.

DISCUSSION.

C. P. Keiser (Penna. Terminal): On the Pennsylvania, we have two electrified divisions, the West Jersey and Seashore and the Manhattan division, both divisions being operated by steam men. The entire organization, including those in charge of the power houses, substations, transmission lines, and the maintenance of the electrical equipment is under the direction of a master mechanic; that is also true of the third rail. Some may think this is primarily a maintenance of equipment matter, yet we find that the substation and transmission lines and the third rail are so closely allied that they can be handled by one foreman. In fact, in our organization on the Manhattan division, the only additional foreman of department we have, other than what is required on other divisions of the Pennsylvania, is the man who is responsible for the electrical side, that is, the substations and transmission lines, as well as the third rail, outside of which we have a foreman of our power house, and also a foreman in the shops. The foreman who has charge of the locomotives, and has the maintenance of the multiple unit cars, is a steam man with twenty years' experience in roundhouses and in general locomotive shop practice.

PENNSYLVANIA RAILROAD COMPANY, MANHATTAN DIVISION.

Electric Locomotive Detentions in Minutes During 1912.

Month	ELECTRICAL				MECHANICAL		Total, All Causes	Mileage	Miles per Minute Detention
	Fuses	Master Control	Motor Control	Misc. Electrical	Misc. Mechanical	Brakes			
January...	..	2	...	...	...	..	2	84,422	42,211
February..	..	5	6	5	...	..	16	78,100	4,881
March.....	..	3	...	...	...	..	3	82,573	27,524
April.....	..	2	...	...	...	..	2	78,886	39,443
May.....	..	2	...	...	...	..	2	80,880	40,440
June.....	..	5	...	...	...	2	7	80,013	11,430
July.....	...	...	...	...	...	..	.....	84,283	.....
August....	..	...	2	...	4	..	6	85,486	14,248
September.	..	...	5	...	4	2	11	83,950	7,632
October...	..	...	...	...	4	7	11	85,305	7,755
November.	..	...	6	...	...	..	6	84,473	14,079
December..	..	...	...	...	...	..	.....	86,221	.....
Total....	..	19	19	5	12	11	66	994,592	15,070

EXPLANATION OF DELAYS.

Master Control:
- 2 minutes. "J" switch not operating owing to oil on armature.
- 2 minutes. Grease on master controller drum.
- 2 minutes. Broken control battery plate.
- 3 minutes. Loose master controller finger.
- 2 minutes. "J" switch sticking; motors not operating in parallel.
- 1 minute. Bent finger on No. 2 controller plug.
- 4 minutes. Master controller finger loose.
- 3 minutes. Bridge relay finger not making contact; small piece of waste found under same.

Motor Control:
- 6 minutes. Circuit-breaker not resetting owing to glycerine in dash pot gumming, account cold weather.
- 6 minutes. Due to motorman not using power in proper manner and blowing breaker by notching up too rapidly.
- 2 minutes. Broken strap connection.
- 5 minutes. R-5 resistance strap breaking No. 2 motor.

Miscellaneous Electrical:
- 5 minutes. Shoe cable burning off.

Miscellaneous Mechanical:
- 8 minutes. Latch on engine coupler opening when starting.
- 4 minutes. Motor crank disk striking cover (stopped to examine same.).

Brakes:
- 2 minutes. Brakes failed to release promptly.
- 4 minutes. Defective air hose.
- 5 minutes. Loose finger on pilot governor of air compressor.

Mr. Quereau has mentioned the article published in the *Electric Railway Journal* on May 15. The total number of detentions due to locomotives in 1912 was 66 minutes, and the mileage was 994,000. Thirty-eight of those minutes were due to electrical causes, and a portion of the detentions on the electrical side were due to improper handling of the locomotives. The delay due to the master control was 19 minutes; motor control, 19 minutes; miscellaneous electrical, 5 minutes; miscellaneous mechanical, 12 minutes; brakes, 11 minutes; so that the detentions are very low. In fact, the electrical side to the repairs to the locomotive is practically nothing. After two and a half years, we have our first armature to rewind or coil to replace. The parts are easily removed and it takes a mechanic but a short time to get the slight experience necessary to make these changes and to know the functions of the various contacts, etc. In fact, our engine men who operate the electric locomotives, after six months, are very familiar with the equipment, and in many cases make repairs out on the road on a failure from loose connections of some sort. On many projects for the electrification of steam railroads, I think it does not require any special organization for taking care of them, that is, of the equipment, the power house or substations.

S. A. Bickford, (N. Y. C.): My experience corroborates Mr. Quereau's statements. He addresses himself to men who have the shaping of the policy of an organization. It might be well to dwell briefly on the organization of the maintenance force. It is true you will need some few men who have had some knowledge of electrical equipment, just as you do in repair shops on steam locomotives where you must have men who have had special training for some particular line of work. After the organization is once started, it can be readily taken care of, just as you take care of your working force in the average engine house. The personnel of the men in the average repair shops for electrical equipment does not differ from that in the repair shop for steam locomotives.

In our entire organization, we do not have what might be known as a technical man, except in the case of those who are there in the capacity of students; they come for the experience they get. Our force is entirely made up from practical men. My personal opinion is that the electrical engineer has up to the present time confined his efforts entirely to the electrification of roads and the design of electrical equipment, and is not so much concerned at the present time about the maintenance. You will need, in addition to these men, a few men who can exercise supervision over the operation and handling of the machine, who are thoroughly familiar with that particular type of equipment. At the present time, the electric locomotive has not reached the high state of reliability and development that car equipments have. This is due largely, I think, to the much increased loads placed upon the electric locomotive over the average car equipment. Each particular type of electric locomotive has its own peculiar weaknesses just as would develop in any machine, and in a high speed express train service, like that which we have on the New York Central, it is important that you have men who are thoroughly familiar with the particular type or the grouping of the apparatus on your locomotive. Aside from that, I do not know that it needs any special training to fit in to successfully meet the problems that are present in handling the electric locomotive, and meet these emergencies as they arise in actual operation.

G. W. Wildin, (N. Y., N. H. & H.): For years the New Haven has had a couple of branches electrified; one is the Nantasket Beach line which operates about three months in the year, and is handled by the master mechanic, along with the steam line, and I never hear from him. We have another line running from Providence to Fall River and Bristol, operating 106 trains a day, direct current, and that is handled by the master mechanic along with his steam operation, both power house and equipment, and there are no complaints about that line.

We have, as some of you know, a very peculiar situation in our electrified zone; we have a very complicated arrangement. Until the first of this month, I did not have full control of the operation of that line, but it was under the control of what we term an electrical superintendent, who kept all the mysteries under his hat, who would tell you nothing, and would do nothing, and consequently we were in a pretty bad fix. We have reorganized the division, placed a master mechanic on it, a man with steam railroad knowledge, and have made him a superintendent of shops to report directly to the mechanical superintendent, and the chief engineer of the power house reports to the mechanical superintendent. The master mechanic handles the outlying shops which wou would term round-houses in steam service, and has nothing to do with the main shop or main repairs which are made, but he does make all the running repairs. I have an assistant mechanical superintendent who gives his full time to this end of the work, and who has grown up on the steam lines, and I got him principally because he knew nothing about electricity. What he does learn now will be a real knowledge of electricity. I thoroughly concur in the statement of Mr. Quereau, but I want to go a little further, and say that 99 per cent. of the knowledge required in the operation of electrical service is mechanical knowledge, and one per cent. electrical knowledge. You should not put your electrical equipment in the hands of electricians; if you do, you will be in trouble. It is a notorious fact that they know nothing about mechanical parts, and as long as they keep the copper portions in running order, and a few other electrical parts in proper condition, they think that they are keeping the locomotive up to a standard condition. What you need is good sound sense behind the whole situation, and not very much theory.

President Crawford: Is there any further discussion on

this paper? If not, we will proceed to the consideration of an individual paper entitled "A new Locomotive Testing Plant at the University of Illinois," by E. C. Schmidt, professor of railway engineering, University of Illinois.

LOCOMOTIVE TESTING PLANT.

Professor E. C. Schmidt, of the University of Illinois, presented an extensive individual paper describing the new locomotive testing plant which was recently installed at the University of Illinois. The paper was quite similar to one which was presented at the March meeting of the Western Railway Club, and which was abstracted in the *Railway Age Gazette* of March 28, 1913, page 752.

DISCUSSION.

D. R. MacBain, (L. S. & M. S.): I think the paper just read by Professor Schmidt is one worthy of a great deal of study on the part of the membership, and I believe it is going to be a very valuable document as I feel that the railroads will more that ever in the future avail themselves of the opportunities of testing on such plants; and I move that the Association extend a vote of thanks to Professor Schmidt.

(Motion seconded, stated and carried).

A. W. Gibbs (Pennsylvania): Will it trouble Mr. Schmidt too much to tell us how successful the method of separating the sparks has proven to be? It is not a difficult problem, and as the plant has been running since April, perhaps he could give some information as to how completely that practice serves its purpose, separating the solid matter from the gases.

Professor Schmidt: As far as our experience goes thus far it is successful, as we are trapping either in the duct or in the collector, all the solid matter. We have not, however, run this locomotive up to its capacity. The plant has been in operation only a month ,and is new, and what with interruptions, we have not had more than 10 days' continuous running, so that we are not in position to draw very satisfactory conclusions from the operations, as yet.

A. W. Gibbs: Does any of the dust from the coal sift down onto the roof?

Professor Schmidt: Not so far as we are able to discern. It is discharged 80 feet above the ground, and there might be something get away which we would find. We have means of exploring the stack; there is a manhole in the stack above the separator, which will enable us to explore the gas stream and determine if there is any considerable amount of solid matter which gets away. Thus far we have not done that. The separator to which I refer is of almost identical design and of the same proportions as one used by the Lackawanna, as called to my attention by one of their men located at Scranton. They have had a good deal of experience with that device at that point. For some reason or other they found it necessary to separate the sparks in the gas discharge of the stationary power plant.

President Crawford: We will now proceed to the report of the committee on Main and Side Rods, of which committee Mr. W. F. Kiesel, Jr., is chairman.

MAIN AND SIDE RODS.

The report on the above subject was submitted two years ago, was discussed at the last meeting, and was held over for a year for consideration, to be brought up again at this meeting for possible adoption as a standard. During the past year we have received a number of letters, some containing suggestions, as follows:

As it will be but a short time before heat-treated and alloy steels are introduced, maximum allowable stresses for such materials should be recommended.

That allowable pressure per square inch for pin bearings be specified, and a ratio of length to diameter of pins be established, especially for high-speed engines.

Offset rods for locomotives with three pairs of drivers sometimes have all of the offset in rod between two drivers, and none between the third and middle driver. It is then not positively necessary that the total offset be taken as leverage for bending.

These suggestions have been considered, but were not deemed of a nature to require changing or adding to the previous report. Taking them in their order, the committee reports as follows:

We are not yet justified in giving a limit of stress for heat-treated or alloy steels, as too little is known concerning such material in actual locomotive service.

The design of pins is necessarily handicapped by the available space, therefore the designer is restricted, and must obtain best results regardless of preferred bearing area and desired ratio of length to diameter of pin. Furthermore, the design of pins is not a part of the problem submitted to us.

A general rule for type of offset rods described can not be formulated without danger of having it misapplied. The rule as given may err slightly on the safe side, but can not be misapplied. It is therefore preferable to make no change.

W. F. KIESEL, JR.
Chairman, Committee on Main and Side Rods.

Attention is called to a correction that should be made in the original report:

In Volume XLIV, 1911, page 137, at bottom, a change should be made, as follows:

The minimum area at points indicated by letter "b."

For main rods and main pin bearing of side rods, A equals. $\frac{Px}{30000b}$

For side rods, except main pin bearing, A equals $\frac{Px}{60000b}$

The report, including the correction just noted, was submitted for adoption as standard practice.

The report is signed by:—W. F. Kiesel Jr. (Penna.), chairman; H. Bartlett (B. & M.); G. Lanza; H. B. Hunt (Am. Loco. Co.), and W. E. Dunham (C. & N. W.).

DISCUSSION.

J. A. Pilcher, (N. & W.): This report has been before the association for two years, if I am correct, and under the resolution passed yesterday, it could now be adopted as a standard.

President Crawford: It could be adopted as "Recommended Practice."

J. A. Pilcher: Isn't it permissible to adopt it after it has been before the association for one year?

President Crawford: The idea is that anything adopted would remain a recommended practice for at least one year. While it is true it has been before the association for two years, it can be adopted today for recommended practice if the association so desires and remain as recommended practice for at least one year.

J. A. Pilcher: I move that this be adopted as recommended practice before the association, and that the committee be discharged. (The motion was carried.)

F. F. Gaines: Last year there was some discussion on this paper relative to the question of why in American practice the rods are so much heavier than in European practice. I did not believe at the time, and I do not now, that that is the case. I noticed in a recent issue of the *American Engineer*, a gentleman of the Baldwin Locomotive Works has an article on the subject, and he shows that American practice as compared with European practice is quite similar when you consider related parts, the size of the cylinders and the other parts involved.

Henry Fowler, (Midland Railway, Derby, England.): I have not it checked, but I should decidedly say yours are heavier when you take that into account. When we purchase rods, they are subjected to very careful heat treatment.

President Crawford: If there is no further discussion on this report, we will take up the next report, which is on Safety Appliances. I am the Chairman of that committee, and the report of the committee is that nothing transpired during the

year which has lapsed since the last convention, for this committee to give consideration.

H. T. Bentley (C. & N. W.): I move that the report be accepted.

(Motion seconded and carried).

President Crawford: The next report is that of the committee, on "Design, Construction and Inspection of Locomotive Boilers" of which Mr. D. R. MacBain, superintendent of motive power of the Lake Shore and Michigan Southern is chairman.

D. R. MacBain: I have asked Mr. Gaines to kindly read the report, as my voice is not in good shape.

MAINTENANCE OF LOCOMOTIVE BOILERS.

The committee reported relative to the maintenance of locomotive boilers, the report on design and construction being presented to the members at the last convention.

ELECTRIC AND OXY-ACETYLENE WELDING.

The committee has investigated the results obtained by electric welding, especially for fire-box work, and has included in the report results obtained by oxy-acetylene process, which is used extensively. Some roads install electric welders in such a location that they can be used in the shop as well as the engine house. The oxy-acetylene can be arranged in the same manner by running pipes from the central plant to any part of the engine house or shop.

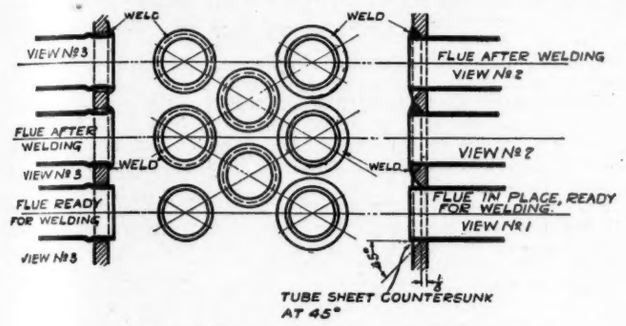


Fig. 1—Methods of Welding Flues.

A complete portable oxy-ecetylene cutting and welding outfit is also used in both shop and engine house.

One road, using the electric process, welded beads of small and large superheater tubes, after they had been set in regular manner but they gave trouble on account of leakage. It proved successful where the material of the flue was in good condition. An experiment was made by the same road on three engines omitting copper ferrules and it did not prove successful on account of not countersinking the sheet to allow for welding the bead on the flue.

A road using the oxy-acetylene process has welded in a number of small tubes and omitted copper ferrules; they could not make satisfactory welds with the ferrules. The tube sheet was prepared as shown in Fig. 1. View 1 shows the tubes set ready for welding; the tubes were not expanded in any manner. View 2 shows the tubes after being welded. The tubes are allowed to project far enough beyond the sheet so that when finished the beads are the same size as when beaded in the regular manner. They experimented with flues welded as shown on view 3. Tubes were allowed to extend through the sheet 3/16 in. and were prossered and then welded after which a beading tool was used to smooth up the bead. This set of flues has been in service only a short time, and so far has been satisfactory.

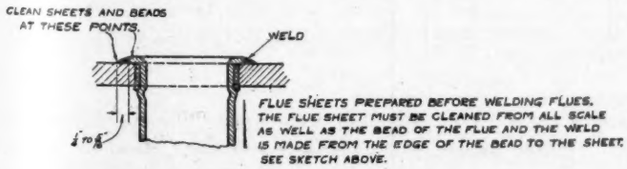
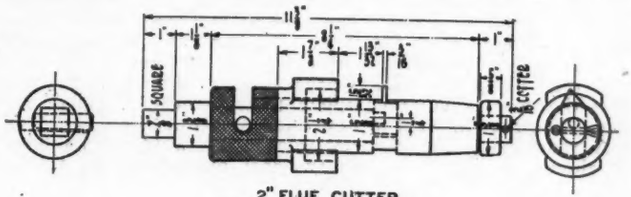

CLEAN SHEETS AND BEADS AT THESE POINTS.
WELD
FLUE SHEETS PREPARED BEFORE WELDING FLUES. THE FLUE SHEET MUST BE CLEANED FROM ALL SCALE AS WELL AS THE BEAD OF THE FLUE AND THE WELD IS MADE FROM THE EDGE OF THE BEAD TO THE SHEET. SEE SKETCH ABOVE.

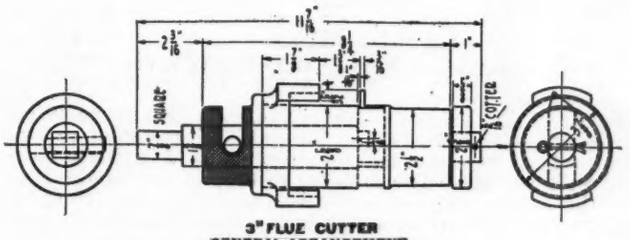
Fig. 2—Welding Flues, Electric Process.

A road using oxy-acetylene process for welding in flues believes that the copper ferrules are not necessary. The flue sheet is prepared as follows: The old flue having been removed, the first operation is to draw the centers of the back and front flue sheets toward each other. The center of the back sheet is drawn forward about 1¾ in., and the front sheet is drawn backward about 1½ in. This is accomplished by applying eleven stay rods distributed in a circle about 2½ ft. in diameter, one of the rods being located in the center. While these rods are under tension the back flue sheet is annealed around the edges by an oil torch. Rods are then removed and there is a permanent dish in the back sheet of about 1¼ in., and in the front sheet 1⅛ in. The holes are then countersunk on the fire side to a depth of ¼ in. with a countersinking tool, the cutting faces of which are at an angle of 90 degs. Flues are then set in place, projecting ⅛ in. beyond the flue sheet, then rolled and ready to be welded. They have not undertaken to weld any large superheater flues.

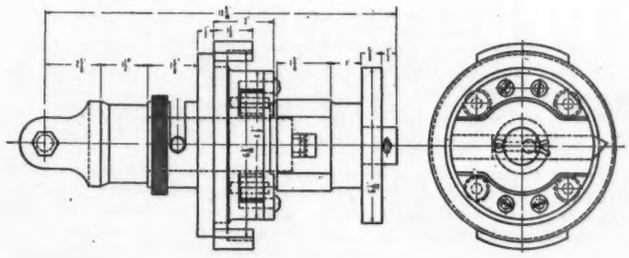
One road had considerable difficulty with the large superheater tubes in the back flue sheet, and one engine which had a flue mileage of 75,000 miles was brought to the shop and large flues welded with electricity. Nothing was done to flues or beads except to clean them before welding. Metal was built around the bead as shown in Fig. 2, and the weld was made from the edge of the bead to the sheet. The ferrules and flues were prossered and rolled, and have proved so successful that this method was continued. The engine was placed in service and has made 14,000 miles without giving any flue trouble. On one division they have 96 superheater engines having a total of 3,024 large superheater tubes, all welded, and 24,655 small tubes, of which 3,557 are welded. The total flue mileage of these 96 engines is 1,117,437 miles, and up to date there has not been one case of welded flues leaking. This practice has been extended over the entire road. It is unnecessary to adopt a special method of welding tubes other than what was followed previously for prossering tubes.



2" FLUE CUTTER
GENERAL ARRANGEMENT



3" FLUE CUTTER
GENERAL ARRANGEMENT



8½" SUPERHEATER FLUE CUTTER
GENERAL ARRANGEMENT

Fig. 3—Flue Cutting Tools.

Two roads using the oxy-acetylene process chip off the high spots and use an ordinary beading tool; others do not go over flues in any manner. Roads using electricity find it unnecessary to smooth off the welds. The majority of roads which weld in flues use steel safe-ends and no difficulty is experienced. It has been found that it takes about three hours longer to cut out a set of flues which have been welded. In removing these flues no special difficulty has been encountered. Fig. 3 shows tools used in removing flues that have proved very successful.

When flues are welded-in, the maintenance is less than

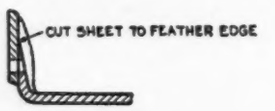
when tubes are prossered. It is unnecessary to give any special attention to welded tubes when boilers are washed. Reports received from different roads indicate that considerable difficulty was experienced in welding flues with the oxy-acetylene process, while the roads using the electric process report very satisfactory results, especially one of the roads that tried out both methods and adopted the electric process. Therefore, the committee recommends electric process for welding flues, and also recommends that flues be set with coppers, prossered and beaded in regular manner before welding, until it is clearly demonstrated that other methods are equally as good or better.

One road using oxy-acetylene for welding the flues reports that it costs, including gas and all work preparing flue sheets and safe-ending flues, an average of 71 cents per flue, and the regular method, which consists of safe-ending and applying coppers and other work for the same number of flues, is 22 cents per flue.

A road using oxy-acetylene for setting the flues, as shown in Fig. 1, reports that a set of welded flues, containing 335 flues, amounts to $18 for labor, $15 for gas, making a total of $33, or $.098 per tube. No coppers are used by this road when welding in tubes. The regular method for the same number of flues costs $25.25, or $.075 per flue. These figures include only such work as necessary to set flues.

A road using the electric process of welding flues reports that the cost of labor complete to weld beads is $.037 per flue. The cost to weld in new flues is $.03 per flue.

A road using the electric process for welding the flues as shown in Fig. 2 reports the cost of welding 34 4½-in.



ELECTRIC WELDED

Fig. 4—Method of Welding Door Sheets to Mud Ring.

tubes and 32 2-in. tubes—labor, $4.12; current, $2; material, $1.25. Total, $7.37. One 4½-in. tube is equivalent to two 2-in. tubes; therefore, this amounts to 100 2-in. tubes costing $.073 per flue. The standard method of setting the flues by the same road, which consists of safe-ending, applying coppers and prossering, is $.089 per flue, and adding the cost of welding ($.073) makes a total of $.162, which is the cost of welding one 2-in. tube, as shown by Fig. 2.

Below is the cost of setting flues by different roads. This cost applies to the old method:

A. $.06 a flue ready for testing, new flues.
B. $.06 a flue ready for testing, new flues.
B. $.14 removing, cleaning, safe-ending and resetting.
C. $.13 removing, cleaning, safe-ending and resetting.
D. $.067 installing copper ferrules, setting flues, rolling front ends, setting and beading firebox end of tube.
E. $.044 per flue for setting tubes only, includes copper ferrules.
F. $.04 per flue for setting tubes only, includes copper ferrules.
G. $.036 per flue for setting tubes only, includes copper ferrules.

From these figures, it appears that the cost of welding flues in accordance with electric process is cheaper than the oxy-acetylene process. It also gives better service. None of the roads are welding-in tubes in the front tube sheet, as it does not seem to be desirable to change the method now used.

Vertical cracks in the side sheets are welded with both oxy-acetylene and electric process. Seven roads get good results with electric process when cracks do not exceed 12 in. in length. Two roads advised very poor success with welding vertical cracks with the oxy-acetylene process. The method used by all railroads is to V out the sheet ⅜ in. to ½ in. at the top and ⅛ in. to 3/16 in. at the bottom.

Cracks in the top of the back flue sheet as long as 38 in. have been welded successfully with both types of welder The sheet is cut out a few inches beyond the end of the crack to avoid a new crack from starting, and is dressed out V shape the same as the cracks in the firebox. Some roads preheat the sheets before welding.

Cracks are successfully welded in the crown sheet with both processes. One road, using oxy-acetylene process for welding cracks at the flue sheet, cut off the forward part of the crown sheet and welded a strip the full width of the crown sheet, about 6 or 8 in. deep. This was done to avoid any new cracks developing at this location. It was found that this gives more serviceable results.

Cracks in the door sheet have been successfully welded with both types, but the oxy-acetylene is preferred, as it gives more satisfactory results. One road preheated sheets before welding.

In preparing firebox sheets for electric welding, the crack is V'd out to an angle of about 65 deg. and the metal is filed bright. For oxy-acetylene it is V'd out to an angle of about 90 degs. and no filing is required; the metal is built up from the fire side of the sheet.

Considerable difficulty has been experienced by roads using both oxy-acetylene and electric welding on account of welded cracks opening up after service from three to eight months. The percentage in some cases, which are few, runs as high as 15 per cent. About 5 per cent. is the average.

It is considered that very good service is obtained in welding cracks and sheets in fireboxes by both processes. Most of the difficulty was experienced in the earlier days when this method was new. The same can be said of new cracks developing adjacent to welded cracks. This trouble is very rare and it is not serious.

Some roads using oxy-acetylene use water on each side of the weld, and others preheat the sheets to take care of the expansion and contraction. Roads using electric welders do not have any special method of taking care of the expansion and contraction.

When welding cracks in the firebox sheets which embrace three or four staybolts, the best practice is to remove the staybolts, whether broken or not, and weld the sheets solid and drill new holes.

When renewing broken staybolts in the vicinity of cracks in the firebox sheet, which have been welded, occasionally a weld will open up due to vibration of hammers used in chipping, calking, or driving up staybolts. These cases are rare, however, and the second weld made usually holds good. To prevent this, some roads endeavor to keep the sheets hot while driving bolts.

Bridges have been welded in both front and back tube sheets with both processes and give fairly good results, although some roads have had difficulties with oxy-acetylene. Sheets in some cases must be preheated before and at the time of welding to take care of expansion and contraction, also to prevent cracking of adjacent bridges. Flue holes are rolled while the sheet is hot.

Full firebox sheets are welded successfully with both types of welders, and in some cases experiments have been made with welding the flange of the flue sheet and the door sheet to the side sheet, omitting the rivets.

One road had a switch engine built at a locomotive works, and all the firebox seams were welded with the oxy-acetylene process. There are no rivets in this firebox except the ones that fasten the box to the mud ring. Engine went into service August, 1912, and has given no trouble with the seams leaking, or otherwise. Three-quarter door sheets have been welded in by one road and the rivets have been omitted where the sheet is welded to the side sheet. Another road

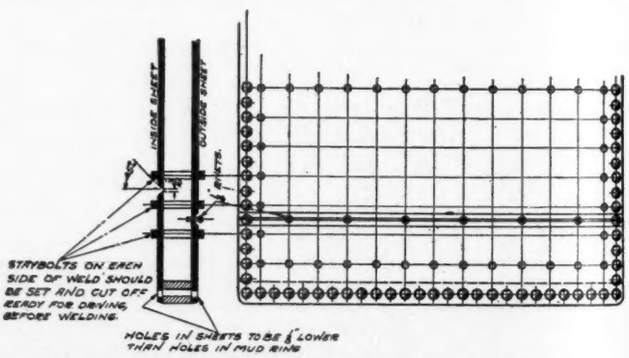

INSIDE SHEET
OUTSIDE SHEET
RIVETS
STAYBOLTS ON EACH SIDE OF WELD SHOULD BE SET AND CUT OFF READY FOR DRIVING, BEFORE WELDING.
HOLES IN SHEETS TO BE ⅛" LOWER THAN HOLES IN MUD RING

Fig. 5—Method of Applying New Strips Around Bottom of Side Sheets, Throat Sheets and Back Head by Oxy-Acetylene Welding.

reports having welded door sheets from the firebox door down to the mud ring. The rivets were cut out and plugs screwed into rivet holes which were cut off flush with the sheet and welded over as shown in Fig. 4. Fig. 5 shows method of applying new strips around bottom of the side sheet, throat sheet and back head.

One road welded a patch in the side sheet by oxy-acetylene, July, 1909, which was removed March 1, 1913, having made a mileage of 136,980 miles.

Another road, using the electric process, reports that some patches in firebox side sheet fail in from one to three months. Patches in the crown sheet give no trouble. Door-hole collar gives good service, and any patches in the firebox, applied round or oval, will give better service than square ones which are welded on three or four sides.

Another road, to overcome the difficulty they were having with the vertical welding, applied patches, cut diagonally.

Since adopting this practice they have been very successful with the oxy-acetylene. Plugs and sunflowers have been successfully welded with both processes. The plugs were applied in the usual manner and then welded around the edge, the same as welding flues.

There have been cases where staybolt holes and washout-plug holes have become enlarged, and holes, in some cases, especially the staybolt holes, have been welded up entirely, redrilled and retapped for new bolts with satisfactory results. On washout-plug holes patches have been applied 4 or 5 in. in diameter and welded and new holes drilled for the plugs; washout-plug holes have been reinforced around the hole for a distance of ½ in. or more. This work has proved very successful with both types of welders.

Welding of cracks in mud rings have been successfully done with both types of welder. Mud rings have been welded on the firebox sheets at the corners in addition to riveting, to eliminate mud-ring leakage and have proved very successful. Building-up of metal at the mud rings is done by roads with both types of welder and has proved every successful.

The committee feels that there is a field in which each of the two welders, that is, electric and oxy-acetylene, excels the other. For welding seams, cutting out and removing old sheets, the oxy-acetylene excels. For welding flues, short cracks and welding metal, where expansion must be taken care of, the electric welder excels. At engine houses the committee would recommend that electric welders be installed, and at shops, both electric welder and oxy-acetylene process be used, as oxy-acetylene process can be kept busy cutting out and applying new sheets.

BOILER WASHING.

It is the consensus of opinion of the roads reporting that boilers should be washed with hot water. This method avoids sudden change in temperature and by this process the staybolts firebox sheets and boiler being washed clean in a shorter time. Most railroads now install hot water plants when building new roundhouses.

One road reports having a special boiler-washing plant which consists of two washout pits about 150 ft. long. The engines are placed on the pits and connected up to blow-off cock with a high-pressure flexible hose. This is connected to a pipe line which conveys the steam and water into a filtering plant, which consists of three large tanks with a total capacity of about 30,000 gallons. It is equipped with two motor-driven Buffalo turbine pumps, which pump the water out through another line for washing and filling of locomotive boilers. All water used in washing, runs back into the tanks by gravity system and pass through the filtering pits of hard coke, etc., on its way to the tanks. They advise that this plant is very satisfactory, as there is no loss of steam or water from boilers or tenders.

Another road has installed its own system which provides for the blowing off of all water and steam from the boilers to the tank. The foul water from this tank flows off to the sewer. The steam separates and passes to a concrete cistern which is filled with fresh water admitted by a thermostatic control. The steam enters this cistern through two pipes at the top, the pipes extend down close to the bottom of the cistern. At the end of the pipes are 4-in. noiseless heaters. The steam heats the water in the cistern to 140 degs. and when the temperature rises above 140 degs., more water is admitted automatically, the supply shutting off when the temperature reaches 140 degs. The water is then pumped from this cistern to the roundhouse and is used in washing and filling boilers. The exhaust steam from the pumps is piped to the cistern for heating purposes. There are a number of patented systems now on the market.

One road advises that it takes two hours and thirty minutes to wash a boiler with hot water, from the time the locomotive is brought in and placed on the pit, completely washed, replace the plugs and get the engine under steam ready for service.

Some roads have gone so far as to install the hot-water system in old engine houses, where a large number of engines are handled.

When washing with cold water, care should be taken that the boiler is properly cooled before cold water is turned into it. The general practice is to remove two washout plugs in the backhead above crownsheet, connect the cold-water hose to the feed pipe, which allows the cold water to pass through the injectors and boiler check and mix with the hot water in the boiler, thereby allowing the water to escape through the washout holes. By this method the boilers may be fairly well cooled down, and after this has been accomplished all washout plugs are removed, which will allow the boiler to drain itself. With this method it consumes more time than washing out the boilers with hot water. It requires from forty to sixty minutes to cool the boiler down. One road using cold water reports that it takes six hours and twenty minutes to cool a boiler down, wash it, fill it, and fire it up again ready for service.

The washing of a boiler is a local proposition and depends on the water conditions which have to be met; therefore, no hard fast rules can be recommended by this committee to govern the washing of boilers.

After the boiler is washed, the flues are examined carefully and any flues not welded, which show signs of leaking, are gone over with a prosser. Fig. 6 shows a straight prosser used for small and large tubes. These tools are used for re-working tubes.

Some roads prosser full sets of flues every thirty days, using a long-stroke air hammer. If leaking between this time they are expanded by a sectional prosser expander, driven to place by a hand hammer or beaded with the air hammer and beading tool. The form of the beading tool must be kept to original dimensions by frequent gauging.

One road takes into consideration the mileage, combined with time element; for example, re-set every four weeks on freight engines that have made 8,000 miles or over, and every six weeks on passenger engines making 6,000 or 8,000 miles.

The flue mileage varies from 40,000 to 60,000 and one road

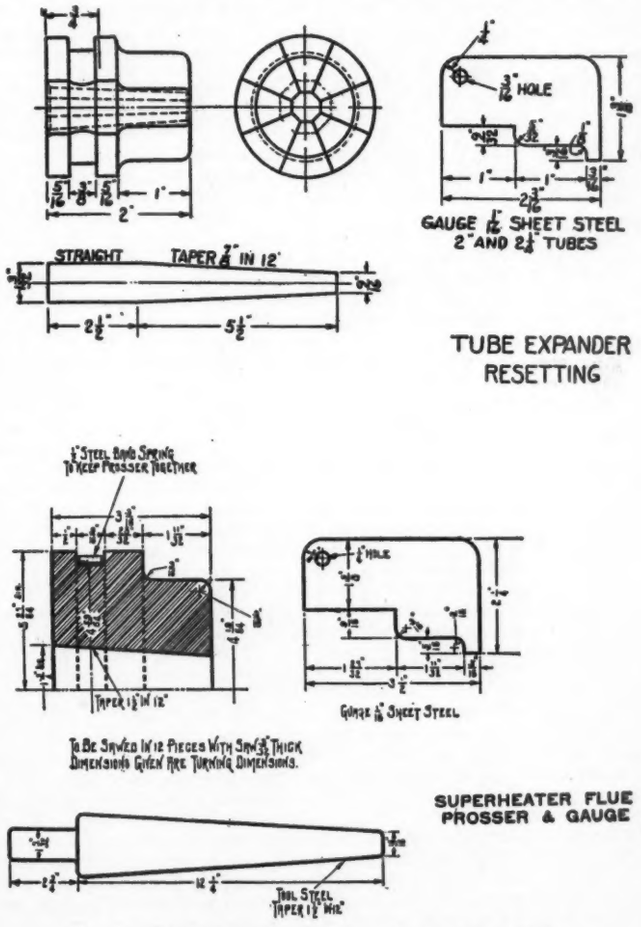


Fig. 6—Straight Prosser for Re-working Tube.

reports having obtained 75,000 miles. No rules can be recommended for fixed flue mileage. This must be governed by local conditions. If flues are welded in, the present indications are that they can be run for three years, which is the limit prescribed by the Federal Rules.

WATER CONDITIONS.

A few roads have what would be called good-water conditions. Practically all roads are using treated water in some form. A few roads are using a boiler compound which is made in stick form about 18 in. long and is applied after the boilers have been washed, through the washout holes and laid on the crown sheet and a few sticks are laid on top of the flues at the rear end. This compound has increased the mileage between washouts over 150 per cent. on a road which has very bad water conditions, and it has been in use almost a year. In addition to increasing the mileage between washouts, it has increased the life of boiler flues.

It is important to keep the arch tubes free from scale, and when washing boilers it is the general practice to use

a Cyclone cleaner through each tube until all scale is removed. The Lagonda arch-flue cleaner is used by a good many roads. The cleaner is started into arch tubes at the boiler head. It is driven by air and a small stream of water is entered through a separate pipe for the purpose of washing down the scale. The cleaner is run through gradually, making sure to remove all of the scale from the arch tubes.

In order to get the most efficiency out of a boiler, it is necessary to keep the flues from stopping up. Some roads blow out flues at the end of each trip, especially on important power. Others blow them out at each washout. The blowing is done with air pressure from 100 to 120 pound , using a ¼-in. pipe for blowing out the superheater flues, and ⅜ to ½-in. for other flues.

All roads, except one, who have a large number of superheaters in service, report no difficulty with the small superheater tubes clogging up on the inside. They found some of the units almost closed up at the return bends, which was caused by the use of too much soda ash and by foaming.

FLEXIBLE STAYBOLTS.

Your committee reported at the convention last year that one of the members applied a full installation of flexible staybolts to a locomotive firebox in February, 1907, with the exception of four bolts under the auxiliary dome, four under the steam turret and eight bolts which go on top of same at back head. February, 1908, engine received general repairs and firebox was in good condition. All caps were removed from flexible staybolts and they were found to be in good condition. April, 1909, it was found necessary to patch the top of the back tube sheet on account of sheet cracking from the hole around the flange; this was done in the engine-house. October, 1909, engine was given general repairs, and by this time the top of back tube sheet had given out in two more places, but as the sheet was in good condition otherwise, it was patched. Three mud-ring corners also required small patches applied. After rattling scale from firebox sheets with large hammer, it was found that forty of the flexible sleeves had cracked outside of the sheet, and on being taken out they were found to be crystallized, but no broken bolts were found. In 1911, engine was again in the shop for general repairs and had all caps removed from flexible staybolts and bolts found to be in good condition. A patch was applied to top flange of flue sheet, half side-sheet seam in firebox was in good condition. In July, 1912, the engine was given general repairs, and at this time it was necessary to apply new back tube sheet; caps were removed from all flexible staybolts and none found broken. Side-sheet seam has never given any trouble and engine has lost no time in roundhouse due to broken staybolts since the box was applied. Mileage up to May 6, 1913, is 398,997 miles.

The application of staybolts with some form of slack, is believed to be desirable as it relieves the firebox of excessive internal stresses which would be brought into play if the bolts are turned up tight.

BRICK ARCHES.

To get the most efficiency out of a brick arch it must be maintained properly and not often disturbed. The general practice seems to be to remove the center row of bricks when it is found necessary to bore or work on flues. Only enough brick should be taken out to enable the operator to get at the tubes. They must be removed as carefully as possible to avoid breakage. Some roads have a special brick-arch man, day and night, at the large terminals to make repairs to arches and to see that they are kept in good condition. Brick arch should be blown off with air by a pipe put in through the firebox door with a tee on the end which will blow the dirt, or a portion of it, to the corners where there is an opening which allows it to fall out on the grates.

The report is signed by:—D. R. MacBain (L. S. & M. S.), chairman; C. E. Chambers (C. of N. J.), T. W. Demarest (Penna.), R. E. Smith (A. C. L.), F. H. Clark (B. & O.), J. Snowden Bell, and E. W. Pratt (C. & N. W.).

DISCUSSION.

H. T. Bentley: I was interested in the different methods of welding in flues and we are just experimenting a little bit, and my impression is that the method shown at sketch *A* is not nearly so desirable as that shown on sketch *B*, for the reason that when you want to remove the flues with the former method, you must have a special tool to get the flue out, whereas by the method shown in sketch *B* you have only to have an air-chisel and cut the old portion off flush with the sheet. While I have heard a good many things said in reference to welding the flues in favor of the sketch *A* method, it seems to me to be the longer process, and not as satisfactory as the one shown in sketch *B*. I notice a referenc to vertical cracks in side sheet. Everybody seems to think that the welding of a horizontal crack is a better form and will last better than the vertical crack. The committee made the statement that the cracks in crown sheets are successfully welded with both processes. Some time ago we had an electric welding outfit, and the first thing we asked them to do was to weld a crack overhead, and after they worked on it and apparently succeeded (it was in the case of an old fire-box) we got a piece of the sheet and put it on the testing machine and there was no strength in it at all. We got a second electric welder from another form and made a similar experiment with practically the same results, and we finally got a third electric welder and welded a crack in the crown sheet, and this was done very successfully, the strength of the welded part running up to 75 or 80 per cent. of the original strength of the sheet. I am glad to note the committee thinks it is not difficult to weld cracks in crown sheets, because I considered it was one of the most difficult places to weld, especially with electricity.

We welded a large number of sheets in with the oxy-acetylene process, before we went into the electrical process, and I want to agree with the committee in their statement that both the electric and oxy-acetylene processes have their uses. I do not think there is any question that the oxy-aceylene is very much better for certain work than the electric welding process, and that the best thing to do is to have both of the methods available in your shop, and to use the one which will give you the best results in any particular case.

I would like to ask the members if they are having any more trouble with pitted flues than they used to have. At one time, in one of our districts where we used rather bad water, we occasionally found a few flues pitted, but lately we are having a tremendous amount of trouble in this direction, and we are trying to overcome it. Where the flue is not badly pitted, but has a few deep holes, we weld it up with electricity and oxy-acetylene, and apparently these flues are giving good service. I think it might be of interest to find out whether the pitting of flues is more general now than it has been, and if so, how can it be done away with, and what is the method by which to overcome it?

C. L. McIlvaine (Pa.): On the Pennsylvania we experimented in welding the flues with an oxy-acetylene process three years ago. The two holes in the flue sheet were countersunk and there was a number of flues first welded in at various locations, both at the front and back end, the idea being to stay the sheets, after which the remaining flues were welded with the oxy-acetylene process, the operation requiring about two weeks' time. It was very slow, because only one man could work in the firebox, owing to the excessive heat, it being necessary to blow air into the firebox to enable him to work continuously. That experiment proved a complete failure, as did all the experiments with the oxy-acetylene process.

About a year ago, we began using the electric process and had uniformly good results. We made a great many micro-photographs of sample welds of both processes. I have inspected a number of samples of welded flues, etched with micro-photographs, and they show a uniformly better weld is made by the electric process. The oxy-acetylene process usually shows a large amount of oxide and slag included, and these are absent in the electric process. However, unless the electric weld has been properly made, it will be porous, and that emphasizes the necessity of hammering and cleaning the work as we go along. The first locomotive with the welds in has been running for about 15 months, and made about eighty or ninety thousand miles; it is a Pacific type. There has been no leakage except with one tube where it was sweating a little. Five more engines running about eight or nine months averaged about forty thousand to fifty thousand miles each, and they have had no leaks with the exception of one engine which had one tube leaking slightly, due to a pin-hole caused by the fact that the operator did not clean the job while he was doing it. That was corroded slightly, and it was fixed and has not leaked since. We have now running about forty engines with welded flues, of which eleven are saturated and about thirty-three are sperheater engines. We find we get as good results with the welding of large flues as we did with small ones. The prospect looks very promising, and with this class of engine, with these long flues which are giving so much trouble, we feel assured that if we have almost one hundred per cent. performance with that class we will have no trouble with any other class.

F. F. Gaines: I would like to ask Mr. Bentley what kind of material he has in his tubes.

H. T. Bentley: Steel.

F. F. Gaines: I think that is the answer. We were using steel flues and having the same trouble. We had pitting, and we stopped steel tubes, and that fixed it up. I experimented a long while with acetylene and we could not do much with it, but we have recently put in an electrical outfit

and have welded some of our large tubes which were giving trouble after one year's service, and now they give no trouble; we are hoping to run them for some time yet. We will take the majority of the engines in for tire repairs and setting, but we will miss the tubes, I think, this time. There is one thing advisable which is not mentioned in the paper, and that is, the use of the sand blast preparatory to welding. Unless you get your sheet clean, you will not get a good weld, and the only way to clean it is to do it with a sand blast.

H. T. Bentley: We are using steel flues, but we have been using iron flues also for many years, and I think the iron flues are giving us as much trouble with pitting as the steel flues.

B. P. Flory (N. Y., O. & W.): We have been using the electrical welding process for over a year and a half; we do not use the oxy-acetylene process much now. I have been looking over the paper and I was surprised to learn that some roads have had so much trouble in opening up electrically welded sheets. We have had very little trouble. I remember one of our first jobs having sixty-one cracks in the firebox. We welded it up and it has been in service now over a year and a half and I do not think any of the cracks have opened up. We had the engine in the shop recently and welded up a few more cracks; we have welded the flues in, and so far, have had very good results. We figure that the electric welding process is cheaper than the oxy-acetylene, and also gives better results.

D. R. MacBain: As Chairman of the committee, I deserve very little credit for this paper; the work in compiling the data gathered is entirely due to Mr. Demarest. I want all to understand that, so there will be no wrong opinion.

Now, as to the usefulness of the electric apparatus and the gas apparatus for welding joints, our men on the Lake Shore are well satisfied that each system has its own particular advantage. We were one of the pioneers in gas welding and we have had a great deal of experience, and our men are well satisfied that the electric has its field as well as the gas. We have one of our master mechanics Mr. Foster, here whom I would like to call on to make a few remarks on this subject. He is a pioneer in flue welding on the Lake Shore. He had some engines which were causing trouble and he took them in and welded the old flues in, and had no trouble after that with them for the entire winter.

O. M. Foster (L. S. & M. S.): I suppose the welding of flues is naturally the most attractive use for welding; leaky flues constitute one of the things that has caused considerable trouble. Since we have had the superheaters, while the little flues were always troublesome, the large flues were three or four times as troublesome. We did so much work on the large flues that they deteriorated very rapidly. We started in with a large flue, as they were the things we wanted to get fixed in a hurry. We devoted our attention to welding in old flues, as they were the ones that were making us trouble. We welded the first ones in last September, and today there are 260 superheater engines on the Lake Shore with flues welded in, and few of those engines have full sets welded in. In one case, after welding, we found the engine had to go into the shop in a couple of months and we had enough confidence in the welding to let the engine go through the shop and come out again without touching those flues; and we have not been sorry for it as yet. Of course, the easy thing was to weld the flues as we find them, and our success in doing that suggested naturally some thoughts as to the new installation of the flues. As far as leaking is concerned, it might happen that in one case out of forty there would be a flue or flues that would be spongy, as some one said. That is due to the carelessness of the operator. Sometimes it is necessary to clean sheets stopped up by little pin-holes, sometimes they will take those up themselves, and you do not need to do anything. We use a small hammer under a small tool with a round end on it—that is, it is shaped like the contour of the flue. We use that to shape the flue, knocking off the dirt and scale, and then we take a wire brush and clean it as thoroughly as possible in that manner. I do not think the use of the sand-blast would be advisable as in the hands of a careless operator, it can do a great deal of damage. The results we have in the welding system seem to prove our method as satisfactory, and we get the sheet clean enough for good welding.

In the application of new flues, of which we have done very little, there has been an inclination to counter-bore the hole in the sheet. I think our way is better, because while these are prossered before welding, still it stands to reason that you lose a little. Flexibility there relieves the welding of something it might get if you counter-bore the hole and weld it down; that would make an absolutely rigid condition. Furthermore, it would take more trouble to get that out of the sheet. I am inclined to think that anybody undertaking to weld in flues had better start as we did, to weld in the old beads, and convince themselves as to how they had better go ahead with any new application. We leave the copper in because it was there, and if we make any new installations, we put it in also, because if the weld failed, we would still have the original condition. This has not proved necessary, but I do not know whether or not it will always be necessary to use copper; probably not. We thought, when we welded the flues in the back sheet they would perhaps leak in the front sheet; there has not been anything in that. We have been rather surprised to find the absence of any such difficulty. I believe as a matter of fact, the flues leak less in the front sheets since they have been welded than they did before.

C. E. Chambers (C. of N. J.): We are all pioneers in electric welding. We have had an electric welder in our shop for about a year and four months. Like a washtub, we would not try to keep house without it. We had not welded any flues until this year. We had a superheater engine in service between New York and Philadelphia, and the superheater flues rolled out and gave us trouble. We took the engine into the shop, and welded the flues in with an electric welder, and since that time the engine has been running daily, no attention has been given to the flues and there is no indication of any leakage. At the same time we passed another engine through the shop, a saturated steam engine, and we welded in all of the flues by the electric welder, having gone through the proper process of placing the ferrules and heating, etc., and no work has been done on that engine since that time. We have never experienced any more trouble in welding vertical cracks than in welding horizontal cracks. We have a large number of patches, large and small, and we weld a great number of vertical cracks. We weld a number of crown sheets, making patches of various sizes, and in all instances, this work has proved satisfactory.

E. W. Pratt (C. & N. W.): I want to make a suggestion in regard to flexible staybolts. The report mentions a complete installation of flexible staybolts, in which connection it seems to me that provision should be made for taking up the slack of the front crown bolts, due to the upward movement of the crown sheet. I know of at least one railroad that has a flexible staybolt that permits the cap being removed and this slack taken up, but it seems to me that some bolt of that character should be used more generally if we are to have any strain on the front one or two or three rows of crown bolts. In connection with the welding of the larger superheater tubes it occurs to me that inasmuch as any work that we do on these large tubes is of a more serious character than that on the small ones, we ought to be able to get a longer service than three years out of these large tubes, especially if they are welded in, and notwithstanding the reading of the law, which indicates that all flues must be removed, there is no question in my mind but that the intent of the law is for the internal inspection of the boiler, and in that connection I may say that we have recently had several inspectors from different sections making a thorough inspection of Pacific type locomotives without removing the large superheater tubes. They reported unanimously that non-removal of the large superheater tubes does not interfere with the thorough and complete internal inspection of the boiler; hence, I believe if this matter were taken up in a proper way, and it seemed to be an advantage to the railroads to continue these large tubes in service more than three years, that that might be arranged for.

H. T. Bentley (C. & N. W.): As a matter of information to Mr. Pratt, I will say that we have some engines equipped with flexible staybolts in the crown sheet next to the flue sheet. We took the matter up with the people who furnished the staybolts, which I understood him to stay were originally at the top, and they said that if they furnished that type of staybolt, it was a mistake, because they have a flexible bolt with a screw arrangement on the top which takes up the slack referred to.

D. J. Redding (P. & L. E.): There are two distinct types of welder as I understand it, one being a welder with which you can work only one man, and the other, a multiple unit welding equipment, in which you can work simultaneously four or five or six men, as you may require. I understand that some of the members of the Association have multiple unit equipments. I think it would be interesting to know whether or not they experience any particular difficulty when they come to putting the second, third or fourth man on the welder, and whether they have any trouble in maintaining a uniform voltage for the work. I am also inclined to think that Mr. Pratt's difficulty in regard to the upward growth of the flue sheet and the upward motion of the crown sheet will be largely overcome if he welds in all of his tubes, as that growth is largely due to the repeated working of the tubes.

D. R. MacBain: In reply to Dr. Redding's remarks, I have been informed on very reliable authority that there is only

one concern now, practically speaking, which furnishes welding apparatus and they will give you whatever you want, anything from one to six points. We are installing on the Lake Shore a welding outfit that has four points. The difficulty that existed in the past, which was litigation between a couple of the concerns which make welding apparatus, I believe has been practically settled, so that you will be able to get about whatever you want. The Lake Shore has installed a single point machine in a roundhouse, and about the only repairs, as I understand it, that are necessary on a set of welded flues is that occasionally one comes in with a pin-blow out of it, and the man touches it with a needle and closes it, and that does the job. Our experience has been very satisfactory, and I hope that the information gathered by the committee and put in this form will be of some use to the association.

President Crawford: If there is no further discussion on this paper, we will proceed to the next subject which is the report of the committee on Steel Tires, of which L. R. Johnson, of the Canadian Pacific is chairman. In the absence of the chairman, the report will be presented by the secretary.

STEEL TIRES.

The committee reported no change in the specification presented last year, except to add a new sub-clause: (d) The elasticity shall be at least 50 per cent. of the tensile strength.

The committee has discussed the question of using alloy steels, such as chrome, vanadium, etc., but do not feel in a position to express an opinion.

The report was again presented for consideration, and the

L. R. JOHNSON,
Chairman, Committee on Steel Tires.

committee suggested to the association the advisability of appointing a standing committee on "Steel Tires."

The report is signed by:—L. R. Johnson (C. P.), chairman; J. R. Onderdonk (B. & O.); R. B. Kendig (N. Y. C.); R. L. Ettenger (So. Ry.), and L. H. Turner (P. & L. E.).

The report was received and the recommendations made by the committee were referred to letter ballot for adoption as recommended practice, and the question of making the committee a standing committee was referred to the executive committee. There was no discussion.

President Crawford: The next report is that of the committee on "Minimum Requirements for Headlights," of which I am Chairman. The report will be presented by C. H. Rae, of the Louisville & Nashville.

MINIMUM REQUIREMENTS FOR LOCOMOTIVE HEADLIGHTS.

The committee appointed to report on the minimum requirements for locomotive headlights has kept in touch with the various tests which have been run on headlights in the past year, but do not feel that they are in position to make other than a progress report at this time.

In 1911 the committee sent out circular of inquiry No. 6, which, among other things, requested an opinion as to the functions of locomotive headlights, in which the committee agrees, are as follows:

To warn employees and the public of the approach of a train.

Marker to designate the head end of a train.

To permit the enginemen to observe wayside objects, such as whistle posts, landmarks, etc.

The above requirements can be met by the oil headlight or a light of the same energy as the present oil lamp.

Analysis of the oil headlight and of various tests run in the past year develops the fact that the distribution of the light with the various detail arrangements vary to such an extent that it is impossible to make a simple definition of minimum requirements, i. e., it is impossible to designate the minimum size of reflector and candle-power of the source of light without going into the distribution of the light with the headlight as a whole.

As to high powered lights, as for example, the electric headlights. Tests which have been made in the past year, confirm the conclusion that they are a decided source of danger when used on roads with multiple track and automatic signals; this confirms the resolution adopted by the Association at the 1912 Convention.

The report is signed by:—D. F. Crawford (Penna.), chairman; C. H. Rae (L. & N.); A. R. Ayers (N. Y. C.); F. A. Torrey (C. B. & Q.), and R. Quayle (C. & N. W.).

The report was received and thoroughly discussed, but no definite action was taken, pending the final report of the committee, which will be made by January 1, 1914, and printed and distributed to the members.

President Crawford: We will now have the report of the committee on Subjects, of which George W. Wildin, of the N. Y., N. H. & H., is chairman. The other reports and papers are referred over until tomorrow.

SUBJECTS.

The committee prepared a circular setting forth the subjects which are now before this convention, as well as those which had appeared before the various conventions during the ten years previous—this in order that the members might see exactly what the Association had done and whether or not it was desirable to reconsider any of the subjects.

After receiving various and numerous suggestions and communications, the committee prepared the following program for consideration:

STANDING COMMITTEES.

1. Revision of Standards.
2. Mechanical stokers.

SPECIAL COMMITTEES.

3. Autogeneous welding:
   Covering the investigation of electric, gas in its various forms, Thermit, oil and other special methods of welding, with their limitations.
3. Autogeneous welding.
4. Recommended method of calculating stresses in locomotive boilers.
5. Locomotive, counterbalancing of; does the Rule 1896 meet modern conditions.
6. Maintenance of electric equipment, locomotives and motor cars.
7. Locomotive types.
   Have we reached the limit of Atlantic, ten-wheel and Consolidation types before beginning the development of other and more complicated wheel arrangements.
8. Cylinder lubrication in connection with superheat:
9. Motors for railway shops.
   Various types of both A. C. and D. C., and drives, group or individual—their uses and limitations.
10. Superheater locomotives, with special reference to design of front-end appliances.
11. Proper location and clearances of side bearings on locomotive-tender trucks, both forward and rear.
12. Tonnage rating of locomotives—the most practical method.

INDIVIDUAL PAPERS.

13. Has the increased weight of modern locomotives brought a correspondingly increased efficiency.
14. Piston valves, best types and proportions with superheat.
15. The possible reduction of reciprocating parts on a locomotive, with attending results.

TOPICAL DISCUSSION.

16. Packing rings for pistons and valves in connection with superheat.
17. Locomotive frames, material for.
18. Cylinder lubrication, graphite.
19. Tools and machinery, the safeguarding of.

SUBJECTS SUGGESTED WOULD BE SUITABLE AND DESIRABLE FOR REPORTS OF COMMITTEES.

Air-brake and signal equipment.
Ash pans, design of.
Boilers, design and inspection of.
Boilers, washing and filling.
Cast iron, substitution of for brass on locomotives.
Cylinders, use of cast iron in.
Educating firemen and engineers, recent method.
Electrification.
Exhaust nozzles.
Fire-box arrangement, the best for oil-burning locomotives.
Forgings for driving and engine-truck axles.
Flues, standard spacing of.
Fuel economies.
Grates for locomotives.
Headlights.
Locomotives, electric.
Locomotives, design of trailing trucks.

Locomotives, internal-combustion.
Locomotives, Mallet.
Locomotive performance.
Locomotives, rating of.
Locomotive tend.rs, standard center plates.
Locomotives, steam versus electric.
Locomotives, three-cylinder.
Locomotives, uniform specification for material.
Lubrication, flange.
Lumber, specifications.
Metal, excess amount purchased account of patterns too large or wrong.
Motor cars, comparison McKeen and General Electric.
Motors, variable-speed.
Painting locomotives.
Power versus weight.
Repairs, cost of locomotives.
Rods, main and side.
Safety appliances.
Safety on railroads.
Shops, electric drive in.
Shops, locomotive-repair, cost of.
Smoke prevention.
Stay bolts, flexible.
Steel, alloy and heat-treated.
Tender derailment.
Tender, largest capacity to be carried on two four-wheel trucks.
Tinware, design.
Tires—shrinkage, contour, specifications.
Ton-mile statistics.
Tool steel.
Tubes, leak in.
Tubes length.
Valve gear.
Wheel loads.
Boilers, washing and filling.
Drawbars and buffers.
Examinations, progressive.
Gas producer in railroad shops.
Locomotives, cleaning of, safety first.
Locomotive coaling stations and ash pits.
Locomotive fuel, anthracite as a.
Oil burning, effects of with and without arch, tubes or superheater.
Safety valves.
Tubes, leaks in.

The report is signed by:—G. W. Wilden (N. Y., N. H. & H.), chairman; A. W. Gibbs (Penna.), and C. E. Chambers (C. of N. J.).

President Crawford: If there is no objection the report will be received and referred to the incoming executive committee. We will now stand adjourned until 9.30 tomorrow morning. The reports on Superheater Locomotives and Specifications for Materials Used in Locomotive Construction, and the paper on Three Cylinder Locomotives are carried over.

PEKING TRAMWAYS.—It is said that the Peking Tramway Company has raised a loan of two million francs from a French bank.

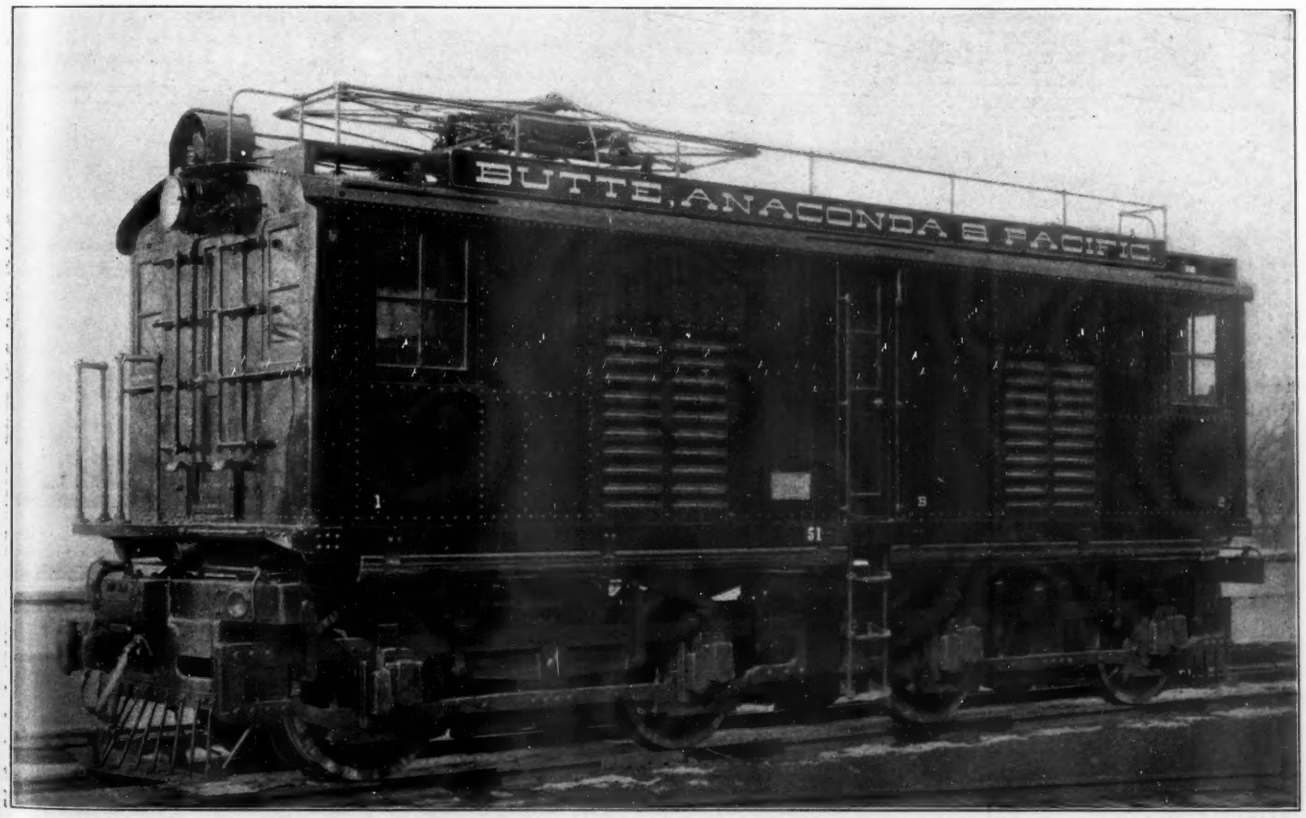
2400-VOLT DIRECT CURRENT LOCOMOTIVE.

Among the most interesting of the track exhibits is an electric locomotive, which is one of an order recently completed by the General Electric Company for the Butte, Anaconda & Pacific. These are the first direct current electric locomotives in this country to use 2400 volts. The traffic on this line consists principally of long trains of copper ore, which are hauled over heavy mountain grades. This service has heretofore been performed by large and powerful steam locomotives. A careful study of all conditions indicated that electric traction could be used to advantage, and the work of conversion has been under way for some time. The plans called for the starting of the electric operation on June 1 of this year.

The section that has now been electrified lies between Butte, Mont., and Anaconda, comprising 30 miles of main line single track, which with numerous sidings, yards and smelter tracks gives a total of about 90 miles, on a single track basis, that have been electrified. The adoption of the 2400-volt direct current system was determined after a thorough study of all local conditions, and it appeared that it gave an opportunity to realize unusual economy, both in initial expenditures and in the cost of operation.

The traffic over this section of the line amounts to practically 5,000,000 tons of freight per year. The trains are nominally made up of 50 loaded steel ore cars, giving a weight of 3400 tons behind the locomotive. These trains will be hauled against a ruling grade of 0.3 per cent. by a locomotive consisting of two units. Single units will be used for making up trains in the yard and for spotting cars.

The initial equipment consists of 17 locomotive units, of which 15 are for freight and 2 for passenger service. Each unit weighs approximately 80 tons and two units, forming a freight locomotive, will be coupled together and operated in the multiple unit system. This combination freight locomotive will haul the full tonnage train at a maximum speed of 15 miles an hour against the ruling grade and at 21 miles



First Direct Current Electric Locomotive in this Country to Operate at 2400 Volts.

an hour on a level tangent track. The passenger locomotives are the same design as the freight except that they are geared for a maximum speed of 45 miles an hour on a level track. A schedule of eight passenger trains, four each way, is maintained and the average train will be composed of a single locomotive unit and three standard steam railroad passenger coaches.

The locomotives are of the articulated, double truck type with all the weight on the drivers. The draft gear is mounted on the outer end of the truck frame, and thus transmits all the pulling and buffing strains directly to the truck frame. The truck frames are formed of heavy steel castings, the side frames being of the truss pattern and connected by heavy end frames and a cast steel center transom. The entire weight is carried on semi-elliptic springs suitably equalized. The two 12 in. steel channels forming the center sills of the center frame have a top and bottom cover plate, thus forming a duct for distributing the air used for forced ventilation of the motors. The air is conducted from the center sill duct through the hollow center pins to the hollow truck transom and thence to the motors.

There is a motor mounted directly over each axle and connected to it by twin gears. The motors are of the commutating pole type wound for 1200 volts and insulated for 2400 volts. A steel pinion is mounted on each end of the armature shaft and meshes with gear mounted on each wheel hub. The gear reduction is 4.84 on the freight locomotives and 3.2 on the passenger locomotives.

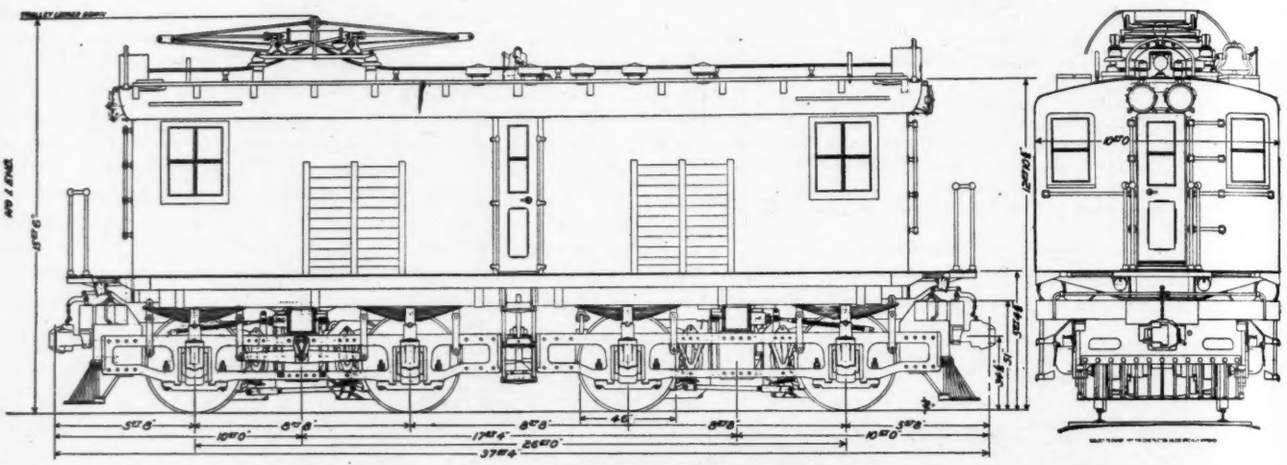
The continuous capacity of each motor is 190 amperes on 1,200 volts under forced ventilation, and 225 amperes on 1,200 volts for the one hour rating. For the double unit locomotive this is equivalent to a continuously sustained output of 21,000 horse power. Air is circulated over the armature and field coils, over and through the commutator, through longitudinal holes in the armature core, and thence exhausted through openings in the bearing head. This method of ventilation circulates a large volume of cool air effectively throughout the motor and keeps all parts at a uniform temperature.

The control equipment is the Sprague-General Electric Type M multiple unit control, and is designed to operate the four motors in series and series parallel. The pairs of motors with their respective resistances are all connected in series on the first point of the controller. The resistance is varied through nine points and finally short-circuited on the tenth or running point. The pairs of motors are then operated similarly in series-parallel and all resistance is cut out on the nineteenth point, which is the full speed running point. This provides a control with ten steps in series and nine steps in series-parallel.

The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. A switch is provided having manually-operated handles for cutting out either pair of motors, so that the locomotive can then be operated with one pair of motors in the usual way. The contactors are actuated by the 600-volt circuit obtained from dynamotor.

Current is collected by overhead trolleys of the pantograph type. They are pneumatically operated and can be put into service from either engineer's compartment by a hand-operated valve. Each passenger locomotive is equipped with two collectors, and each freight unit with one. A 2,400-volt insulated bus line connected direct to the pantograph is run along the center on the roof of the cab. The bus lines are connected by couplers between the two units of the freight locomotive, so that current is obtained from both collectors, or from a single collector. The collectors and bus lines are adequately guarded by railings. A 600-volt bus line is provided on the passenger locomotives for lighting and a 2,400-volt bus line for heating the passenger coaches.

The air brakes are the combined straight and automatic type. The air compressor is two-stage, motor driven, and has a piston displacement of 100 cu. ft. of air per minute when pumping against a tank pressure of 135 lbs. per square inch. Air is taken from the interior of the central compartment. The compressed air in passing from the low pressure to the high pressure cylinder is conducted through radiating pipes on the roof of the cab. This reduces the temperature and allows condensation of moisture before entering the high pressure cylinder. From the high pressure cylinder it is delivered into four air reservoirs, each 12 in. by 164 in. They are located under the floor of the cab and connected in series, which affords a further opportunity for radiation and condensation.



Elevation of One Unit; Butte, Anaconda & Pacific Electric Freight Locomotive.

The general dimensions, weights, etc., are as follows:

Length inside of knuckles	37-ft. 4-in.
Height over cab	12-ft. 10-in.
Height with trolley down	15-ft. 6-in.
Width over-all	10-ft.
Total wheel base	26-ft.
Rigid wheel base	8-ft. 8-in.
Total weight	160,000 lbs.
Wheels, steel tired	46-in.
Journals	6-in. by 13-in.
Tractive effort at 30 per cent. coefficient	48 000 lbs.
Tractive effort at one hour rating	30 000 lbs.
Tractive effort at continuous rating	25,000 lbs.

NEW BRAKE BEAM ARRANGEMENT.—The Committee on Brake Shoes and Brake Beams is exhibiting in the Buckeye Steel Castings company's booth (603-605) a complete full size truck showing the new arrangement of brake beams. Members should examine this truck before the report of the committee comes up for discussion on Monday.

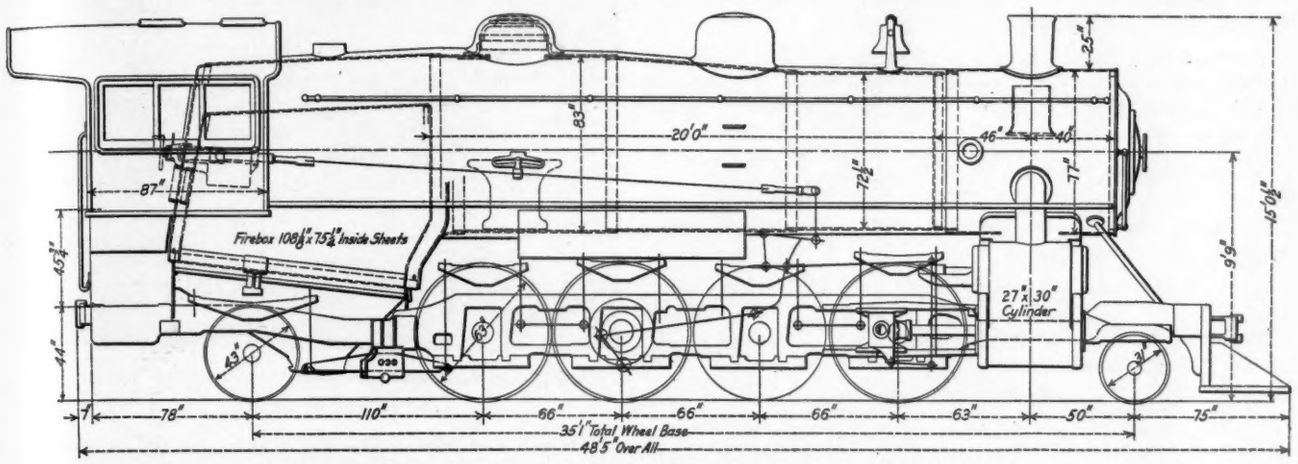
GRAND TRUNK MIKADOS.

Twenty-five locomotives of the Mikado (2-8-2) type have recently been delivered to the Grand Trunk by the American Locomotive Company and an order has been placed with that company for fifty more of the same design.

The freight traffic on the Grand Trunk has until recently been hauled mainly by Richmond compound consolidation (2-8-0) type locomotives, which have a total weight, including the tender, of 349,800 lbs. and a tractive effort of 34,000 lbs. The Mikados have a total weight, including the tender, of 455,100 lbs. and a tractive effort of 51,700 lbs., an increase in weight of 30 per cent., and an increase in tractive effort of 52 per cent. The Mikado locomotives are at present doing their best work on the Western division which has a number of grades which do not exceed 0.6 per cent. except in one case, where a five mile 0.95 per cent. grade requires helper service. The tonnage rating is shown in the accompanying table. These runs are being made at an average speed for the consolidations of 20 miles per hour, and for the Mikados of 22 miles per hour.

	Miles	Helper Service	Consolidation	Mikado	Increase, Per Cent.
Port Huron					
Port Huron to Nichols	156.5	None	2000 Tons	2800 Tons	40
Nichols to Elsdon	168.5	None	1700 Tons	2500 Tons	47
Elsdon to Nichols	168.5	For 5 Miles	2000 Tons	2800 Tons	40
Nichols to Port Huron	156.5	None	2000 Tons	2800 Tons	40

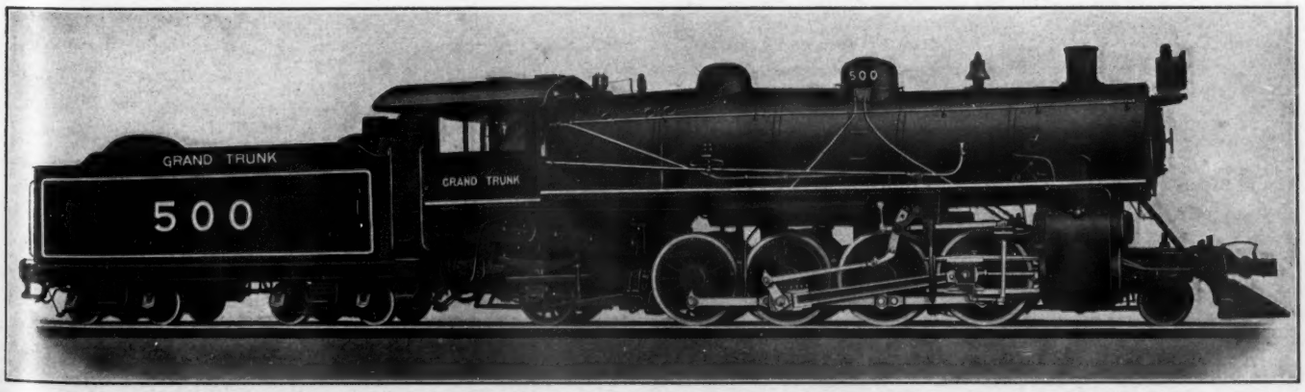
The consolidations use saturated steam and have a total heating surface of 2,952 sq. ft.; the Mikados have an equivalent heating surface (evaporative heating surface plus 1½ times the superheating surface) of 4,776 sq. ft., an increase of 62 per cent. over the consolidations with an increase in the grate area of only 11-½ per cent. The design in general follows the standards of the builders. The boiler is of the extended wagon top type, is 74 in. in diameter at the first ring and 83 in. in diameter outside at the largest course. There are 240 2 in. tubes, 20 ft. long, and a thirty-two unit, Schmidt type, top header superheater. The firebox is 108⅛ in. by 75¼ in. and is fitted with a brick arch, a pneumatically operated fire door and a power operated grate shaker. An interesting feature is the arrangement of the throttle lever support, which combines the lever fulcrum and quadrant support in an integral casting. This makes a saving in the number of parts and also a reduction in the number of holes in the back head of the boiler. The support fits around the stuffing box as a sleeve, and can be turned to any desired angle to bring the lever to a convenient position. The locomotives are also equipped with outside steam pipes, screw reverse gear and self-centering valve stem guides.



Side Elevation Showing Principal Dimensions of Grand Trunk Mikados.

The following table gives a comparison of the principal data with that of the consolidations:

	2-8-2	2-8-0
Tractive effort	51,700 lbs.	33,970 lbs.
Weight in working order	283,000 lbs.	209,400 lbs.
Weight on drivers	213,500 lbs.	183,700 lbs.
Wheel base, driving	16 ft. 6 in.	17 ft. 0 in.
Wheel base, total	35 ft. 1 in.	25 ft. 9 in.
CYLINDERS.		
Diameter and stroke	27 in. x 30 in.	22.5 in. and 35 in. x 32 in.
WHEELS.		
Driving, diameter over tires	63 in.	63 in.
Driving journals, main	11 in. x 20 in.	9½ in. x 12 in.
Driving journals, others	10 in. x 12 in.	9 in. x 12 in.
BOILER.		
Style	Ext. Wagon Top	Ext. Wagon Top
Working pressure	175 lbs.	210 lbs.
Outside diameter of first ring	74 in.	68⅝ in.
Tubes, number and outside diameter	240-2 in.	353-2 in.
Flues, number and outside diameter	32-5⅜ in.	
Tubes, length	20 ft.	15 ft.
Heating surface, tubes	3398 sq. ft.	2757 sq. ft.
Heating surface, firebox	215 sq. ft.	168 sq. ft.
Heating surface, total	3640 sq. ft.	2952 sq. ft.
Superheater heating surface	757 sq. ft.	
Grate area	56.5 sq. ft.	50.6 sq. ft.



Mikado Locomotive for the Grand Trunk.

Conventionalities.

Who will wear the Superheater white pants tomorrow?

The good old summer time seems finally to have caught up with the good old winter time.

Mr. and Mrs. George C. Bardon, Philadelphia, who have not missed the conventions in many years, are at the Shelburne.

Mr. and Mrs. Clarence Mark, Evanston, Ill., reached Atlantic City Tuesday morning and registered at the Traymore. This is their first convention.

Phil Arnold, who is attending the conventions, has just been made manager of the newly created railroad department of the Garlock Packing Company.

A Progressive Euchre party was given on Wednesday evening by Mr. and Mrs. W. C. DeArmond at their summer home, 17 S. Providence Avenue, to their friends who are attending these meetings.

H. M. Edgerton, who has recently accepted the position of engineer of the Standard Car Truck Company, is attending the conventions. He is accompanying James T. Milner, vice president.

L. A. Richardson, mechanical superintendent of the Rock Island Lines, Third District, with office at El Reno, Okla., arrived with his wife Wednesday afternoon. They are located at the Dennis.

M. K. Barnum arrived Thursday afternoon. He had expected to attend the opening session but was delayed because of Mrs. Barnum's illness. She is now recovering rapidly from a case of grippe.

G. P. Robinson, assistant chief inspector of the department of locomotive boiler inspection of the Interstate Commerce Commission, is accompanied by Mrs. Robinson this year and expects to remain for several days.

Burton W. Mudge and wife, Chicago, arrived Wednesday afternoon, and are stopping at the Marlborough-Blenheim. This

From left to right, H. Dixon, Supt. of Shops, C. P. R., W. Toronto; J. H. Mills, M. M., C. P. R., Toronto.

year they are not accompanied by Burton W. Mudge, Jr., or "Junior," as he is usually called.

E. H. Janes, vice-president of the Standard Steel Castings Company, and a member of the Entertainment Committee, has been called to California on business and will not return in time to attend the conventions this year.

William Lodge, president of the Lodge & Shipley Machine Tool Company, sailed Wednesday on the Victoria Louise for Hamburg to join the American forces attending the International Convention of Mechanical Engineers.

C. J. Mellin, consulting engineer of the American Locomotive Company, who was not able to attend the convention last year because of very serious illness, is on hand this time and reports that he has completely recovered his health.

J. C. Kuhns, Purchasing Agent, Illinois Central, is Among Our Guests.

Secretary and director of exhibits H. G. McConnaughy, of the American Electric Railway Supply Association, reports an unusually large demand for exhibit space for the convention of the A. E. R. A. to be held at Atlantic City in October.

J. J. Reid, master mechanic of the Delaware & Hudson at Carbondale, Pa., arrived Thursday. The heavy Mallet locomotives on his division are reported to be doing exceptionally good work and he is quite enthusiastic over them.

Greater ingenuity and skill could not have been shown in arranging the steps and floor at the entrance to the pier so as to cause the maximum number of legs and necks to be broken. Have you been tripped up this morning? Everybody else has.

One of the keenest pangs of regret experienced by the convention visitors is due to the fact that no opportunity will be given George Wilden this year to try his luck at knocking a hole in the Bull Durham sign or running bases a la Mallet.

G. S. Allen, one of the oldest members of the M. M. Association, is attending the meetings with his son C. W. Allen. Mr. Allen, Sr., who is now retired was for 54 years in the employ of the P. & R. and was master mechanic at Tamaqua, Pa.

Axel Levedahl, chief engineer of the Independent Pneumatic Tool Company, Aurora, Ill., sailed from New York for a European trip on the "Lusitania" on May 21. While abroad Mr. Levedahl will visit the prominent ship yards and manufactories.

With a patent first issued by the department at Washington for a new wheel press recording gage, J. W. Motherwell, vice president of the Ashton Valve Company, arrived Monday and registered at the Marlborough-Blenheim. He was accompanied by Mrs. Motherwell.

D. J. Redding, assistant superintendent of motive power of the Pittsburgh & Lake Erie, is accompanied this year by Mrs. Redding and their eldest daughter, Agnes. This is the first convention which Miss Agnes has attended and she seems to be enjoying it immensely.

The troubled look in the eyes of O. S. Beyer, Jr., of the Rock Island Lines, is explained by the fact that he is trying hard to get a paper on Scientific Train Loading and Tonnage Rating ready in time for the annual meeting of the Traveling Engineers' Association in August.

Charles Harter, mechanical engineer of the Missouri Pacific, received a telegram on his way to Atlantic City advising him that his daughter had been made valedictorian of

John Weigle, Retired Motive Power Department Foreman, Pennsylvania Railroad.

her class. She is thirteen, and just about to graduate from the grammar school to high school.

F. T. Slayton, superintendent of motive power of the Virginian, is in attendance at the convention and has some interesting information concerning the performance of the large Mallets which are giving such an excellent account of themselves in handling heavy trains on his road.

W. H. Fettner, master mechanic of the Central of Georgia at Macon, Ga., is enthusiastic over the results which are being obtained from two small switching locomotives which were specially designed for working over sharp curves and are equipped with the Gaines combustion chamber.

A. M. White, superintendent of the Manchester works of the American Locomotive Company, is attending the conventions this year with Mrs. White. He has not been able to attend very regularly during the past few years, and his many friends will be delighted to see him again.

Postlethwaite was a little late in arriving, but his excuse was most commendable. To begin with, he has a daughter at Swarthmore. Then this year Mrs. Postlethwaite's class at Swarthmore held its twenty-fifth annual reunion. What more natural than that papa should go along to show off?

G. S. Goodwin, mechanical engineer of the Rock Island Lines, is being congratulated because of his headquarters being removed from Silvis, Ill., to the general offices at Chicago. He will have charge of problems of locomotive design, while E. G. Chenoweth, with the same title, will be in charge of car design.

The Atlantic City weather man was slow in finding the ball, but when he connected with it he hit the Bull Durham sign. The first three days of this week were overcoat weather, but nothing could have been finer than yesterday. (P. S. This is written at 11.20 A. M. Thursday, and is subject to change without further notice.)

W. P. Richardson, mechanical engineer of the Pittsburgh & Lake Erie, will be missed from the conventions this year. Among the problems which are keeping him at home is one of trying to adjust the counterbalance of some of the new consolidation locomotives by the use of heavy eccentric weights on the axle.

George H. Chadwell, the Woolworth tower of the Safety Car Heating & Lighting Company, registered at the Shelburne in his latest wardrobe creation of black and white checque. George denies that he is soon to start training for the heavy-weight class, as he cannot possibly reduce without serious inconvenience to himself and his many friends.

Paul T. Warner of the Baldwin Locomotive Works made a hurried visit to the convention yesterday, returning to Philadelphia at night. The company's plants are working at present at almost full capacity. He looked very distinguished in the broad brimmed Panama which he purchased at Kingston while on a recent visit to the Panama Canal.

F. J. Harrison, superintendent of motive power of the B. R. & P., has been detained because of illness in his family, and is not expected to arrive before next Monday. The mechanical department of the B. R. & P. is very proud of the fact that all of its passenger trains are now fitted throughout with all-steel equipment.

H. E. Blackburn, apprentice instructor of the Erie Railroad at Dunmore, Pa., is enjoying a few days at the conventions. He has about 57 apprentices under his charge, giving them instruction in drawing and practical mathematics four hours a week and spending the rest of the time looking after their instruction in the practical work of the shop.

J. B. Kapp, assistant master mechanic of the Pennsylvania Railroad at Oil City, Pa., is among the special guests this year. One not familiar with the location of Oil City on the map might have some difficulty in finding it, but it has the reputation of including between three and four hundred millionaires among its population of 13,000.

W. G. Cook, who is attending the conventions, has recently been made railroad representative of the Garlock Packing Company at Chicago. Mr. Cook was until lately secretary to President Worthington, of the Chicago & Alton, and previously

Chas. H. Cory, Honorary Member Ex-Superintendent of Motive Power, Cincinnati, Hamilton & Dayton.

acted for six years in the same capacity for different general managers of that road. He is staying at the Shelburne.

A. B. Appler, mechanical engineer of the Delaware & Hudson, is getting a great deal of satisfaction out of the fact that his office is now located in close proximity to the new general shops at Watervliet, N. Y. It gives him a good

opportunity of following the work in the mechanical engineer's office into practical service and in studying the results.

The technical term for mistakes in the printing art is the word "bugs." Chairman Yardley, of the Enrollment Committee, found a number of "bugs" in the official enrollment list No. 1, Thursday morning. Mr. Yardley promises a better list in No. 2, and at the same time earnestly requests all members and guests to notify the Enrollment Committee of all errors.

The elimination of the ball game feature from this year's convention program is deeply mourned by D. Schepmoes, the publicity man of the Safety Car Heating & Lighting Company. "Skep," not having been informed about the decision to eliminate this feature, had prepared some printed matter of special interest to the numerous rooters hereabout. We advised him to feed it to some of the suckers in the aquarium.

A. R. Ayers, general mechanical engineer of the New York Central Lines west of Buffalo, attended the scientific management meetings of the Western Economic Society in Chicago a couple of months ago. When asked yesterday as to the practical results which followed he remarked that the road was now putting ball bearings on everything in sight.

Henry Gardner, supervisor of apprentices of the New York Central & Hudson River, reports continued good success with the shop schedule at the West Albany shops and the possibility of extending it to other shops on the system. Mr. Gardner is to present a paper on the subject before the annual convention of the International Railway General Firemen's Association which meets at Chicago next month.

The most frequent visitor at the booth of the *Railway Age Gazette* this year is Bob Alter, of the American Tool Works

Two Master Mechanics of the N. Y. C. & H. R. R.

Company. Every time a high speed tool is smashed on one of his machines it is brought to us for inspection, and judging from the number that we have looked over so far the manufacturers of special tool steels will have to wire back to headquarters for more supplies before the end of the week.

Prof. E. C. Schmidt, of the University of Illinois, is feeling very proud about the Transportation Building and Locomotive Laboratory at the University which recently were dedicated with appropriate ceremony. The University of Illinois is rapidly becoming one of the best equipped in the country for training men for railway work. Dr. W. F. M. Goss, who is so well known to those attending the conventions, was unable to come this year.

The students of the Casino Technical Night School at the works of the Westinghouse Company, Wilmerding, Pa., honored George M. Basford on Tuesday evening, June 3, by presenting him with a diploma which they made themselves and which, as a token of appreciation, proclaimed Mr. Basford a friend of the class. Mr. Basford had previously made the commencement address for the graduating class to an audience of over 1,000 people.

Hiram Hammett is having more than the ordinary number of visitors at his booth this year. The enlarged photograph of the convention attendants at the 1888 meeting of the M. M. and M. C. B. Associations at Alexandria Bay is of special interest because so many of the older members who are still attending the conventions are shown in it. The facial adornments, the hats and general make-up offer a great contrast to those now in vogue.

It is quite safe to say that the man attending the convention who has the longest title is G. P. Robinson, assistant

Left to Right—J. B. Randall, M. M., L. H. & St. L., Mrs. Randall, and Chas. H. Bieder, Nat. Mall. Castings Co.

chief inspector, Department of Locomotive Boiler Inspection, Interstate Commerce Commission. His brother is a close second with the title of supervisor of locomotive fuel operation on the Baltimore & Ohio. In size the brothers are rated in the inverse ratio of the length of their titles, G. P. being the smaller one of the two.

Robert F. Carr, president of the Dearborn Chemical Company, is registered at the Marlborough-Blenheim. On the way to the conventions Mr. Carr, in company with J. D. Purcell, stopped off at New York and witnessed the international polo contest; and it is stated, parenthetically, that although Mr. Carr warmly applauded the well earned victory of the American team his pocketbook was noticed with a crimp in it at the conclusion of the contest.

It is only fair to record that the Information Bureau, a photograph of which was shown in yesterday morning's *Daily*, is in the hands of some lightning change artists, and yesterday presented the appearance of a perfectly good place for obtaining answers to questions. It is provided with time tables, programs, a diagram of the exhibits, etc., and is in charge of a man who is fully competent to furnish information on any subject connected with Atlantic City or the convention.

The genial president of the Railway Supply Manufacturers' Association, Sam Allen, practices what he preaches, but he will not preach—in public. He was invited to speak in behalf of the supply men, at the afternoon services at the Atlantic City Y. M. C. A. next Sunday, but after mature deliberation declined the honor. It is a serious question as to why the honor was declined. Was it Mr. Allen's well-

known modesty or was he afraid of the subject assigned him?

W. H. Cook enjoys the distinction of being the only foreign exhibitor at the conventions, assuming, of course, that our Canadian friends on this side of the water are not classed as foreigners. From such records of the association as it has been possible for us to examine, it appears that he is the first representative from across the water, although we have, of course, had many visitors from foreign lands at all of the conventions. He is representing the Fastnut, Limited, of London, England.
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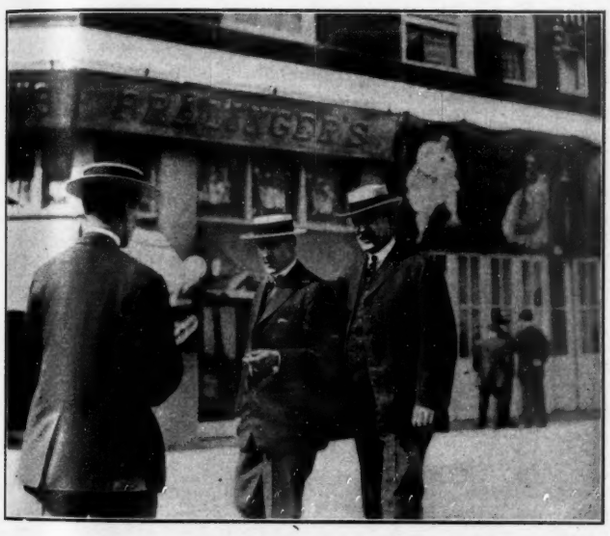
J. S. Sheafe, engineer of tests of the Illinois Central, has Mrs. Sheafe with him again this year and is stopping at the Dennis. He is rather hoarse because of his strenuous exertions in May. Early in the month he addressed the Storekeepers' Association on the Effect of Specifications and the Testing of Materials on the Storekeeper's Stock, and later in the month, as chairman of a committee of the Locomotive Fuel Association, he presented a report on the Scaling of Locomotive Boilers.

J. F. Dunn, assistant general manager (mechanical) of the Oregon Short Line, Salt Lake City, is accompanied only by Mrs. Dunn, their daughters having decided not to attend the conventions this year. Mr. and Mrs. Dunn are at the Marlborough-Blenheim. He gives glowing reports of the business conditions and prospects in the territory of the Short Line. This year's crops are extraordinarily promising, and the population of the country is increasing and its development going forward at a rapid rate.



J. F. DeVoy, Assistant Superintendent Motive Power, C. M. & St. P., with E. D. Garfield, of Manning, Maxwell & Moore, at His Right, and an Interesting Background.

The presence of George R. Carr, Chicago, will be missed at the conventions this year by his many friends, who, however, will be pleased to know that on July 15 he will be united in marriage to Miss Katherine Mortensen, Oak Park, Ill. The wedding will take place at the Fairmont Hotel, San Francisco, and extensive preparations are now being made for the happy event in the Mortensen winter home in Pasadena, Cal. On July 16 the newly wedded couple will leave for Honolulu on their honeymoon trip.

G. S. Edmunds, shop superintendent of the Delaware & Hudson at Watervliet, N. Y., reports that the new shops are getting into good working shape and that they are turning out considerably better than one engine per month per pit. Probably the most interesting feature of the new plant is the foundry for steel castings. Many of the friends of Mr. Manning, superintendent of motive power, were skeptical when he decided to build such a foundry, and it is a source of gratification to all the mechanical officers that it is giving such good results.

H. J. Small, general superintendent of motive power of the Southern Pacific, is naturally one of the most enthusiastic advocates of the conventions being held at his home city, San Francisco, in 1915, in connection with the Panama-Pacific Exposition. A Californian now of twenty-five years' standing Mr. Small descants with as much eloquence as a native son on the beauty, the climate and the resources of the Pacific Coast, and is anxious to give all his fellow-mechanical officers and also the supply men an opportunity to know and appreciate them. Mr. Small is staying at the Marlborough-Blenheim.

George B. McGinty, secretary of the Interstate Commerce Commission, and eleven of the boiler inspection force of the

A GROUP OF FEDERAL OFFICERS.

Left to Right—Locomotive Boiler Inspectors J. McManamy, E. N. Weist, and J. M. Hall; Assistant Chief Inspector, G. P. Robinson; Secretary of Interstate Commerce Commission, G. B. McGinty; Chief Inspector, J. F. Ensign; and Assistant Chief Inspector, F. McManamy.

commission, arrived on Tuesday afternoon and are attending the meetings of the Master Mechanics' Association and the exhibit this week. They are staying at Haddon Hall. Secretary McGinty is greatly interested in the exhibit and has a very high opinion of its instructive value. He hopes to remain through part of next week, when he will be joined by a number of the safety appliance inspectors, who are interested in the work of the Master Car Builders' Association. In the party of federal inspectors this week are Chief Inspector J. F. Ensign, Assistant Chief Inspectors G. P. Robinson, F. McManamy, and District Inspectors J. McManamy, E. N. Wiest, J. M. Hall, Scudder, Pfahler, Winterstein and Nicholas. Mr. McGinty has been secretary of the Interstate Commerce Commission since March 5, when he was appointed to succeed John H. Marble, who was made member of the Commission at that time. He was previously for some time assistant secretary of the commission. He is staying at Haddon Hall. The first secretary of the commission, E. A. Mosely, was for years a regular attendant at the conventions. Mr. Marble, it is believed, never was here while secretary, his service in that office being short. Railway men will doubtless join with the *Railway Age Gazette* in hoping that Mr. McGinty will come often and stay long, for nothing can better promote harmonious relations between the railways and the commission than a better acquaintance between those connected with them.

MASTER MECHANICS' REGISTRATION.

Allen, C. W., Shelburne.
Barnum, M. K., Gen. Supt. Motive Power, Illinois Central, Dennis.
Beyer, F. A., General Foreman, Frisco Lines, Haddon Hall.
Bishop, G. C., Supt. Motive Power, Long Island, Haddon Hall.
Brangs, P. H., Traymore.
Brewer, J. W., M. M., Baltimore & Ohio R. R., Dennis.
Bridges, E. A., M. M., Durham & Southern, Silverdale.
Brown, H. M., Shop Supt., Ches. & Ohio.
Butler, W. S., M. M., Ches. & Ohio.
Byron, A. W., M. M., Penna., Chalfonte.
Carey, J. J., M. M., Baltimore & Ohio, Marlborough-Blenheim.
Clark, F. H., Gen. Sup. M. P., B. & O., Marlborough-Blenheim.
Durham, George, M. M., D., L. & W., Traymore.
Elmer, Wm., S. M. P., Penna. (B. & A. V. Div.), Chalfonte.
Endsley, Prof. L. E., Chalfonte.
Ewing, J. J., M. Engineer, Ches. & Ohio, Seaside.
Finegan, L., D. M. M., B. & O.
Fulmore, J. H., M. M., Penna., Pennhurst.
Gill, John, Traymore.
Givin, E. F., M. E., P. S. & N., Monticello.
Greenwood, B. E., Supt. of Shops, Seaboard Air Line.
Hamilton, Tabor, M. M., Cumberland Valley, Chalfonte.
Irvin, I. B., Gen. Foreman, Pitts. Shaw. & Nor., Monticello.
Kadie, C. H., Lexington.
Keenan, C. E., M. M., N. Y. C., Traymore.
Kirkpatrick, James, M. M., Baltimore & Ohio R. R., Shiltz.
Lide, C. D., M. M., Carolina & N. W. Ry., Lexington.
Lovell, A., Traymore.
Miller, E. A., Supt. Motive Power, N. Y., C. & St. L., Traymore.
Miller, S. W., Haddon Hall.
Moll, Geo., M. M., Phila. & Reading, Jackson.
Montgomery, Wm., M. M., Central R. R. of N. J.
Murphy, F. K., M. M., C. C. C. & St. L., Pennhurst.
Murrian, W. S., Supt. M. P., Southern Ry., Shelburne.
Reagan, F. H., Shop Supt., D., L. & W., Marlborough-Blenheim.
Robertson, D. D., M. M., L. V., Traymore.
Rumney, T., Marlborough-Blenheim.
Ryan, P., M. M., L. & N., Sterling.
Searles, E. J., Supt. Motive Power, B. & O., Marlborough-Blenheim.
Slayton, F. T., Supt. M. P., Virginia Ry., Arlington.
Smith, J. L., M. M., Pitts. Shaw. & Nor. R. R., Monticello.
Smith, W. T., Supt. M. P., Chesapeake & Ohio, Dennis.
Sprowl, N. E., S. M. P., Atlantic Coast Line, Chalfonte.
Thomas, I. B., Supt. Motive Power, Penna., Chalfonte.
Thomson, S. G., Supt. Motive Power, Phila. & Reading, Lennox Apartment.
Turner, J. S., Marlborough-Blenheim.
Turth, John A., M. M., Union Pacific, Chalfonte.
Werst, C. W., Works Supt., Sterling.

MASTER CAR BUILDERS' REGISTRATION.

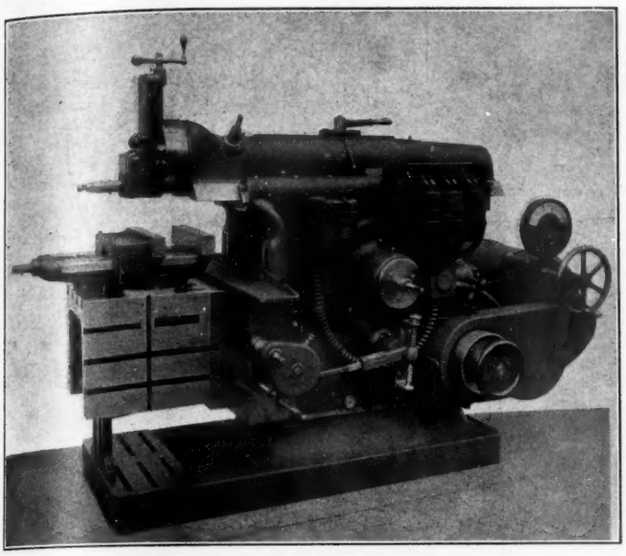
Barnum, M. K., General Supt. Motive Power, Ill. Cent., Dennis.
Beyer, F. A., Gen. Foreman, Frisco Lines, Haddon Hall.
Boutet, H., Chief Joint Inspector, Cincinnati (all lines), Chalfonte.
Bridges, E. A., M. M., Durham & Southern, Silverdale.
Byron, A. W., M. M., Penna., Chalfonte.
Clark, F. H., Gen. Supt. M. P., B. & O., Marlborough-Blenheim.
Clark, J. J., M. M., Tenn. Cent., Dunlop.
Durham, Geo., M. M., D. L. & W.
Elmer, Wm., Supt. Motive Power, Penna., Chalfonte.
Endsley, Prof. L. E., Chalfonte.
Finegan, L. E., D. M. M., B. & O.
Gaskill, C. S., Asst. Engr. Motive Power, P., B. & W., Marlborough-Blenheim.
Hamilton, Taber, M. M., Cumberland Valley, Chalfonte.
Hogsett, J. W., Chief Joint Car Insp., Ft. W. & D., Rudolph.
Kendig, R. B., Chief Mech. Engineer, N. Y. C., Marlborough-Blenheim.
Lide, Chas. D., M. M., Carolina & N. W., Lexington.
Lovell, Alfred, Traymore.
Miller, E. A., Supt. Motive Power, N. Y. C. & St. L., Traymore.
Onderdonk, J. R., Engr. Tests, B. & O., Marlborough-Blenheim.
Parks, O. J., General Car Inspector, Penna., Traymore.
Searles, E. J., Supt. Motive Power, B. & O., Marlborough-Blenheim.
Slayton, C. E., Asst. Supt., St. J. & G. I., Arlington.
Slayton, F. T., Supt. M. P., Virginia, Arlington.
Smith, W T., Supt. Motive Power, Ches. & Ohio, Dennis.
Streeter, L. P., A. B. Engineer, Ill. Cent., Dennis.
Thomas, I. B., Supt. Motive Power, Penna., Chalfonte.
Thomson, S. G., Supt. M. P., P. & R., Lennox Apt.
Turney, E. E., Dist. Car Foreman, M. & St. L. Shops, Schlits.
Twedell, J. W., Car For., St. J. & G. I., Arlington.
Young, J. P., General Foreman Car Dept., N. P. Ry., Dunlop.

M. M. GUESTS.

Adams, C. S., General Foreman, N. Y. C. R. R., Pennhurst.
Bachman, J. H., Motive Power Inspector, Penna.
Bankard, E. H., Purchasing Agent, B. & O. R. R., Brighton.
Baumgardner, F. M., M. M., Ill. Cent., Sterling.
Bradshaw, J. H., Traymore.
Brand, F. L., Chief Eng., Penna.
Bright, Geo. P., Gang Foreman, Penna., Elberon.
Brown, F. S., Mech. Eng., Erie.
Calnan, C. E., Engineer, B. & O.
Case, T. G., Asst. Genl. Foreman, N. Y. C. R. R., Pennhurst.
Chaffee, W. D., M. M., N. Y. C. & H. R., Cheltenham.
Clark, J. J., M. M., Tennessee Central, Dunlop.
Coates, H. T., Jr., Asst. Eng. M. P., Penna., Dennis.
Cooke, D. E., Genl. Foreman, N. Y., N. H. & H. R., Arlington.
Crawford, M. R., Foreman, C. R. R. of N. J., Louvan.
De Salis, J. H., Chief R. For. Eng., N. Y. C., Pennhurst.
Dillon, H. W., C. Dfts., Penna.
Driscoll, F. E., Chief Clerk Purch. Dept., Erie R. R., Dennis.
Eppley, G. Alfin, Islesworth.
Ford, E. J., Supt. Terminal, C. & O., Seaside.
Gardner, J W., B. & A., Marlborough-Blenheim.
Gority, H. E., Insp. Test Dept., Penna., Dunlop.
Gormley, Jos., Train Master, Penna., Jackson.
Hartman, W. J., Gen. Air Brake Instr., Rock Island.
Hattory, M. M., M. C. B., South Manchuria Ry., Traymore.
Hein, J. F., Engineman, Penna., Ellwood.
Huber, H. G., Asst. M. M., Penna., Chalfonte.
Hurley, W. J., Supv. Mech. Exam., N. Y. C., Rudolph.
Ishiki, M. T., Imperial Govt. Rys., Traymore.
Jones, H. W., Shop Inspector, Penna., Elberon.
Keller, F. J., Engineer, Penna.
Kelley, O. J., M. M., B. & O. R. R., Haddon Hall.
Kilcoin, Thomas, Foreman Boiler Maker, A. C. & I., Traymore.
Kurosawa, M. M., Asst. Chief Mechanical Engineer, Korean Govt. Ry., Marlborough-Blenheim.
Lanza, G., Mass. Inst. Tech.
Laumerding, F. A., Foreman, Penna., Haddon Hall.
Levee, George C., Gen. Efficiency Engr., D. & H., Pennhurst.
Lowther, H. F., Asst. Purch. Agt., D. L. & W., Craig Hall.
Lucas, I. N., Engineer, B. & O.
Lytton, M. N., Asst. Road Foreman of Engs., Penna.
Macklin, H. C., Purch. Agt., Seaboard Air Line, Haddon Hall.
Macklin, H. H., Seaboard Air Line, Haddon Hall.
Manning, W. J. H., D. & H., Marlborough-Blenheim.
Matanabe, M. H., Imperial Govt. Ry., Traymore.
McCabe, J. M., Asst. Rd. For. of Engs., W. & S.—Div. Penna., Elberon.
McCarthy, J. H., Material Agent, Penna., Melrose.
McNoldy, W. H., For. Machine Shop, Penna., Dunlop.
Miller, B. E., Master Painter, D. L. & W.
Moll, P. H., Penna., Jackson.
Montague, W. T., Motive Power Inspector, Penna., Chalfonte.
Nunn, A., Insp. Tools & Mchry., Erie, Schlitz.
Osmond, W. H., Asst. Insp. & Pass. Equip., Penna.
Owen, W. F., Pres., N O., M. & C.
Pintell, John, R. H. Foreman, A. C. & I., Traymore.
Powell, James, Chief Draughtsman, Grand Trunk, Traymore.
Purviance, Geo., Jr., Clerk Pres. Office, Penna.
Raymond, P. L., Motive Power Insp., Phila. & Reading.
Rice, W. L., Genl. For., Phila. & Reading.
Roberson, Theodore, Eng. House Foreman, Penna., Chalfonte.
Robinson, W. L., Acct. Supt. Fuel Consumption, B. & O.
Schall, F. E., Bridge Engineer, Lehigh Valley, Bothwell.
Seeger, J. C., Shop Supt., L. V., Lexington.
Shiba, M. G., Mechanical Engineer, Imperial Govt. Rys., Traymore.
Stallard, John H., Engineman, Penna., Haddon Hall.
Strickler, W. L., Chief Draftsman, I. & C., Brighton.
Takaki, M. R., Imperial Govt. Rys. of Japan, Traymore.
Teshima, M. T., Imperial Govt. Ry., Traymore.
Trego, J. G., Asst. Road Foreman, Penna., Jackson.
Tukushima, M. W., Asst. Mechanical Engineer, Imperial Government Ry., Traymore.
Vaughan, H. H., Asst. to V. P., Canadian Pacific Ry., Marlborough-Blenheim.
Webb, T. H., Foreman Tool Room, S. A. L.
Weidhesier, R. W., Engineer, Union Pacific, Commercial.
Wood, Arthur J., Asst. Prof. R. R, Mech. Eng., Arlington.
Yenami, M. T., Asst. Mechanical Engineer, Govt. Rys. of Japan, Traymore.

SHAPER FOR HEAVY SERVICE.

A shaper, specially designed for heavy railroad work, is being exhibited by Gould & Eberhardt, Newark, N. J. It is substantially designed and the frame is so constructed that the ways on each side of the ram are solid, insuring rigidity under heavy cuts. The gearing is more powerful



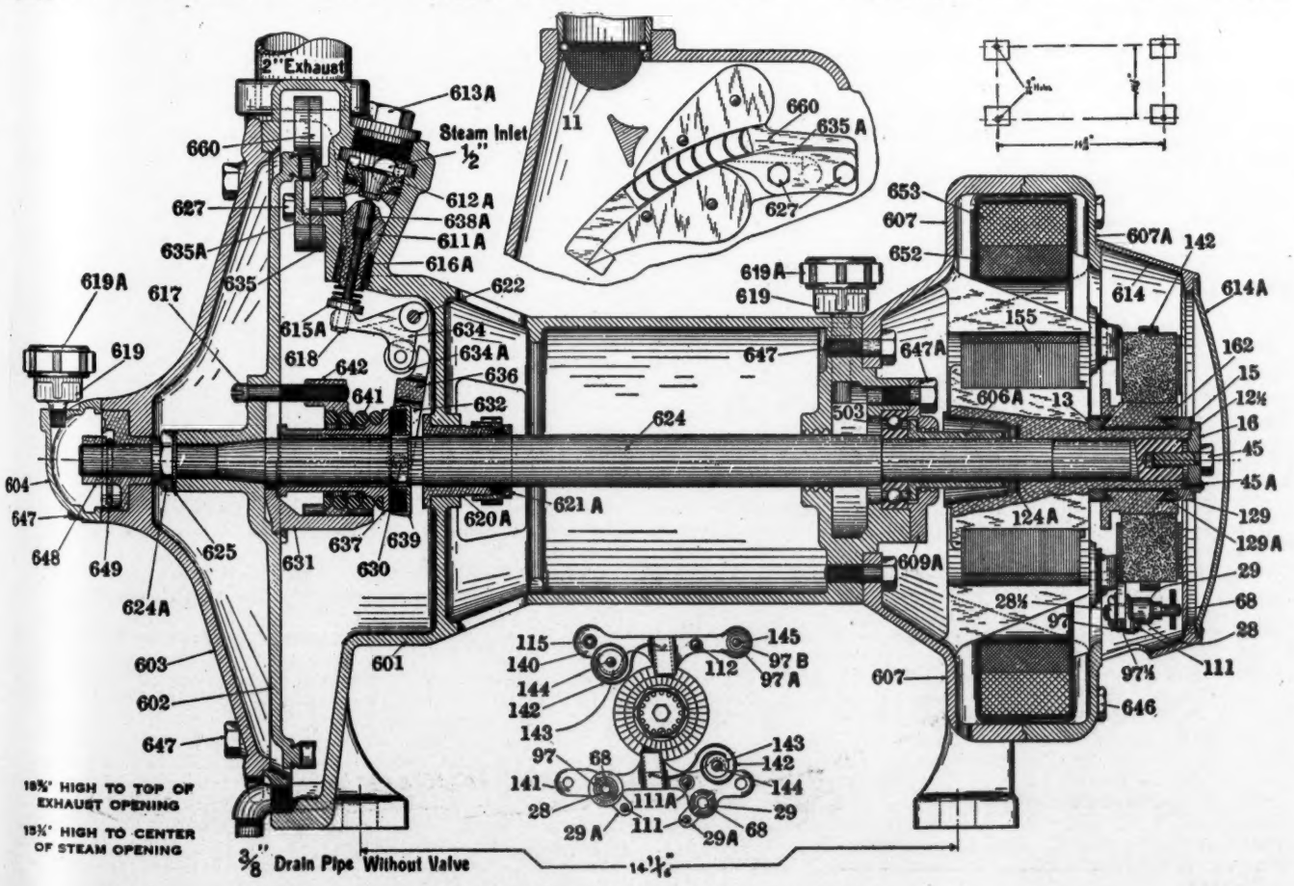
Heavy Duty Shaper.

than that provided in previous machines turned out by these makers and by means of a double train gear drive the machine may be run as fast as 115 strokes per minute.

The shaper is driven by an adjustable speed motor and is equipped with the Electrical Controller & Supply Company's automatic starter and dynamic brake, which enables the operator to start or stop the machine without any friction clutch or brake. The motor arrangement of this equipment is compact and the drive is made through gears from the motor to the machine. A back gear feature, controlled by a lever, is provided and enables the operator to quickly change the speed of the machine to suit his work; there are eight changes of speed for each change of stroke. The cross feed is simple and the amount of feed can be varied while the machine is in motion. The hole under the ram for key-seating shafts has been placed at one side, thus greatly improving and strengthening the machine by making the lever solid and raising the bull gear nearer the ram without changing the lower fulcrum; this adds to the power for heavy cuts at high speed. An oil pocket is provided in the base to catch all drippings and prevent them getting on the floor. The weight of the shaper is 5500 lbs.

PYLE NATIONAL ELECTRIC HEADLIGHT.

The Pyle National Electric Headlight Company, Chicago, is exhibiting its latest improved type E electric headlight. The steam consumption per electric horsepower has been greatly reduced, and the only care required is in the oiling of the turbine end at each strip and the replacing of the carbons. It is only necessary to lubricate the armature bearing once a week. There is no lubrication required on the inside of the machine. The lubrication between the governor sleeve and the governor ring, on which it bears, is accomplished by a composition graphite disc inserted in the ring. The apparatus is so designed that the entire machine may be completely dismantled in eight minutes and re-assembled in the same time. The company has made a special effort to make the machine as simple as possible. The barrel, or main casting, and the turbine yoke are cast in one piece. The generator yoke, or rear field frame, is



Pyle-National Electric Headlight, Type E.

bolted to the barrel, as shown in the accompanying illustration. By removing the front field frame the field coils, armature and all the electrical end of the machine are readily accessible.

The shaft is ground to a fit for the various sleeves placed on it. It runs in a ball-bearing on the armature end and in a brass sleeve-bearing on the turbine end. The turbine end is provided with an oil ring, as shown in the illustration, which keeps the bearing oiled at the various heights of oil in the oil reservoir. The armature bearing is so arranged that any excess oil passing through the bearing will be drained from the casing so that it will not get into the field coils or the armature. The buckets in the turbine wheel are dovetailed into the ring and calked with a copper calking strip, after which they are welded across the top by the oxy-acetylene process. The steam is fed to the valve through a ½-inch pipe and passes through the vanes three times. The machine is regulated to operate at 2,800 r. p. m. by a tension spring governor, which consists of only three parts. This type of governor is used in contrast to the compression type, as it has been found that the turbine shaft will remain in a more perfect balance. The governor is carefully set before the machine leaves the works of the company, and any adjustments that are necessary, due to the wear of the valve, are made in the valve itself. The valve has a lift of only 1-16 in.

The field coils are compound wound, the series and shunt coils being bound together in a compact unit. The brush-holders and springs are so fixed in the casing that they require no attention, except when the carbon brushes have worn away. The generator will take a momentary overload of 100 per cent. From repeated tests it has been found that this headlight will use about 200 lbs. of steam per hour for the full equipment, which is the equivalent of 140 lbs. per h. p. hour. Each machine is given a running test of two hours before it leaves the factory.

REED GEARED-HEAD LATHE.

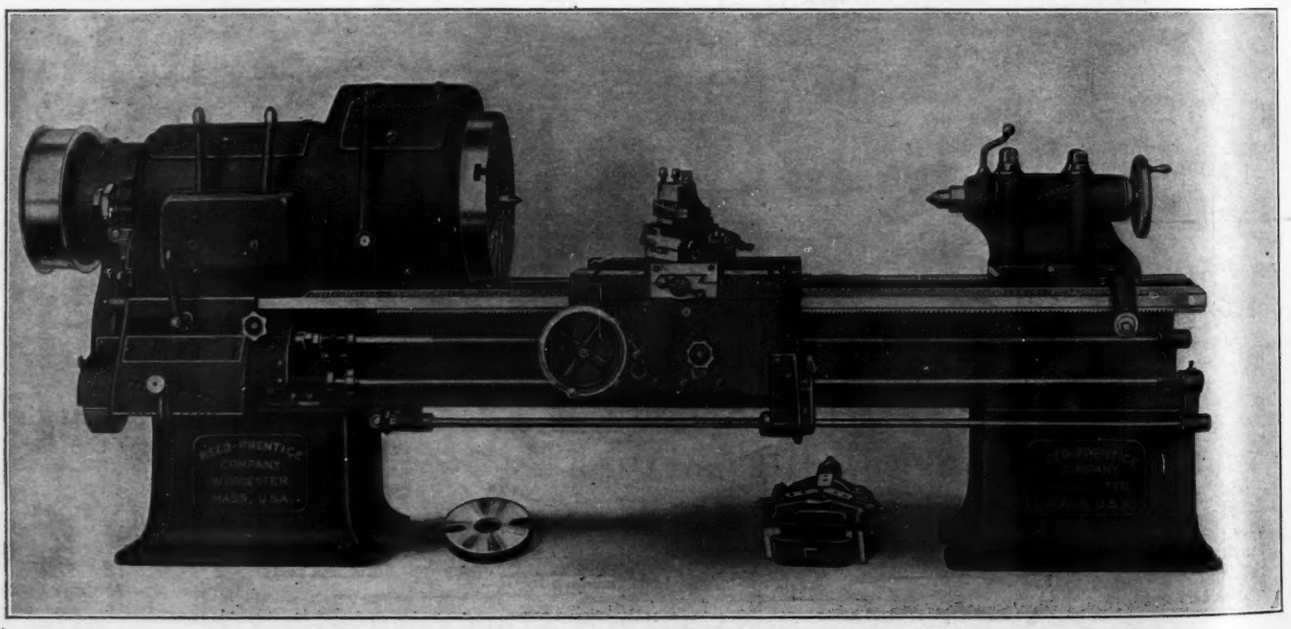
The lathe shown in the illustration is manufactured by the Reed-Prentice Company, Worcester, Mass., and is a 20 in. machine of the geared-head type. There are 13 gears with which 18 spindle speeds may be obtained. Any of these speeds may be instantly obtained and as the gears are always in mesh, it is almost impossible to damage them, the shock when changing speed being taken care of by a friction clutch. This clutch makes it possible to change speed quickly and safely while the lathe is working. A single pulley drive is used, the pulley running on ball-bearings.

The lathe is equipped with a spindle reversing mechanism in the head-stock by which the spindle can be started, stopped or reversed through a handle located at the right-hand end of the carriage. This brings all the necessary changes within control of the operator without his having to move about. The machine is equipped with the Reed quick change gear box which gives 60 changes to both the lead screw and feed rod; all the gears in the front box are made of steel. The reverse lever at the front of the apron moves a double bevel pinion and can be set for feeding in either direction, or in a neutral position which will stop all gearing in the apron. An automatic lock-out connected with the reverse lever makes it impossible to engage the lead screw and the feed rod at the same time; the bearings are all large and well provided with oiling facilities. The lathe can be arranged for motor drive if desired, the motor being mounted on a bracket attached to the rear of the head-stock leg.

HEAT TREATED STEEL AXLES.

The effect of correct heat treatment on carbon steel axles is well demonstrated by the exhibit of the Pollak Steel Company, Cincinnati, Ohio. Two axles of ordinary open hearth steel of 45-point carbon content which have gone through a special process of heat treatment are shown. One is bent cold through 180 degrees by a 250-ton press, while another is bent cold flat on itself under a 20-ton steam hammer, in both cases without evidence of distress or rupture of material.

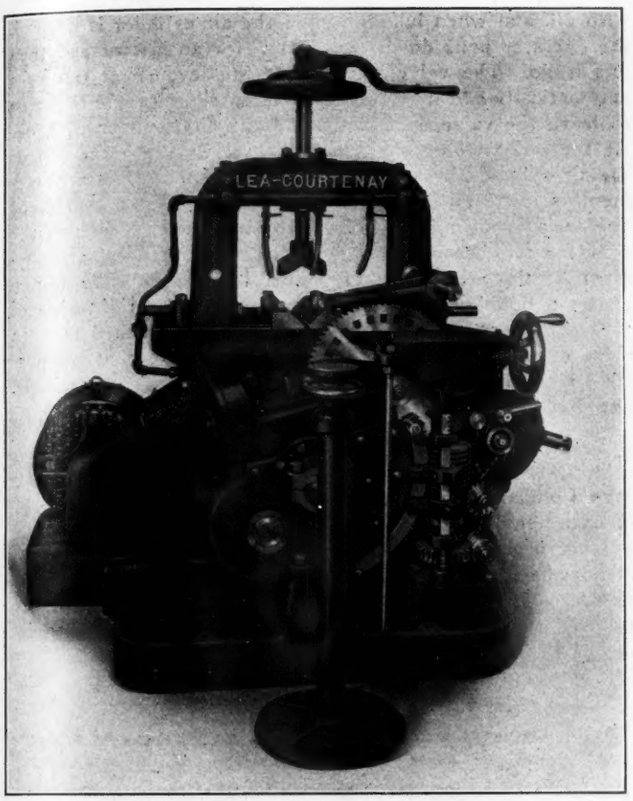
Another unique feature of this exhibit is a half forged car axle, showing half of the axle forged and the other half in the billet state. This gives an excellent idea of how much reduction in forging from the square billet to the finished axle should be given to secure material that has been properly forged.



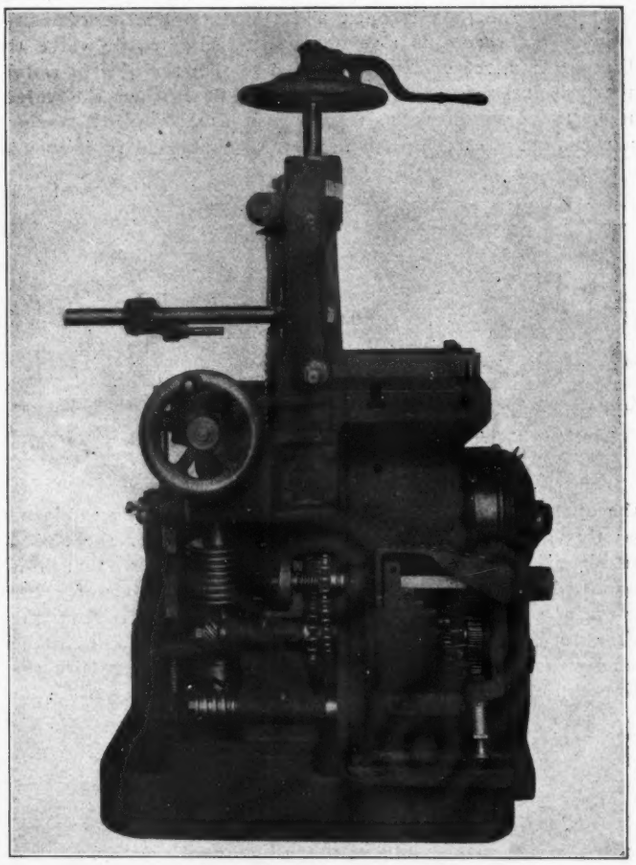
Reed 20-Inch Geared Head Lathe.

COLD METAL SAW.

The Lea-Courtney Company, Inc., New York, are exhibiting two of their sprocket driven cold metal saws, one of which is fitted with an inserted tooth blade. These machines are driven by variable speed motors and the general design is the same in all of the sizes, except the larger ones, where there are some slight differences in the details of the swing arm. The frame is made in two pieces, the upper part being joined to the base at a point slightly above the level of the liquid in the lubricating tank, so as to guard against all leakage, and the two sections are securety bolted together to secure rigidity and correct alinement. The swing arm or saw carriage turns on heavy trunnions, one of which is mounted on the center of the frame and the other is supported on the outside by an outboard bearing over a heavy pedestal. The trunnion next to the frame is fitted with an oilless bearing because its location makes it probable that an operator would neglect to oil it. The saw is fed into the work by means of a heavy quadrant working against a large worm on the vertical shaft. The power is transmitted from the main drive shaft to the sprocket shaft by means of heavy gears. The spur gears are of cast steel and the two bevel gears are planed from a high grade of tool steel. The feed mechanism is the result of much experimenting to eliminate the weaknesses of previous construction. On the No. 21 machine any one of nine different rates of feed can be obtained almost instantly by moving a lever. The feed box is driven by means of a roller chain, taking its power from the main drive shaft of the machine. The capacity of these saws ranges from 3½ in. to 8½ in. on round bars and on square bars from 3½ in. to 8¼ in., depending on the size of the machine.



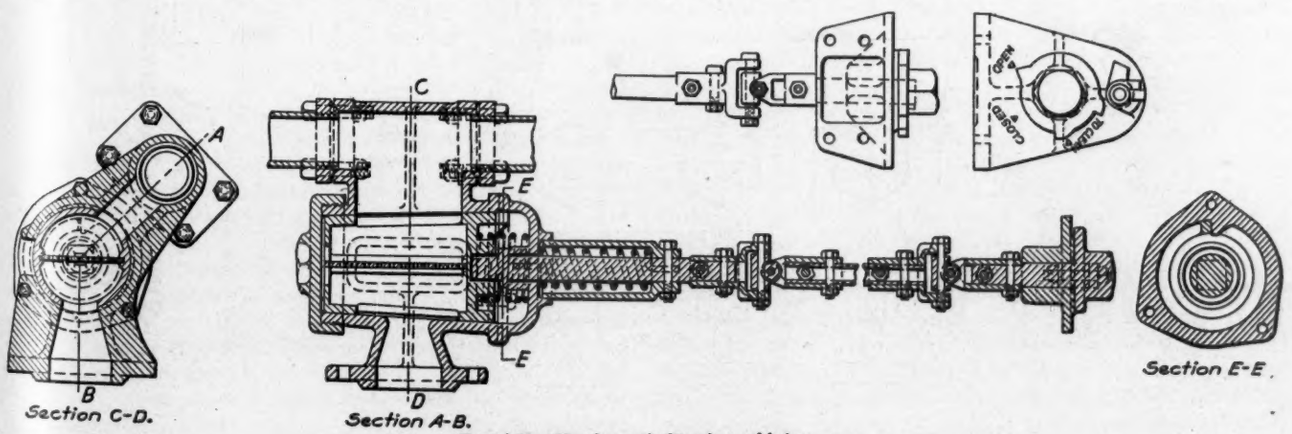
Cold Metal Saw.



Rear View of Lea-Courtenay Cold Metal Saw.

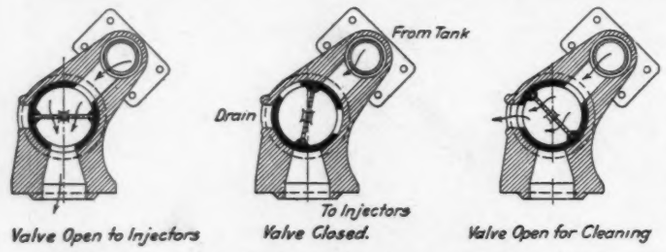
TANK AND STRAINER VALVE.

The device shown in the illustrations is intended to perform the functions of both the tank valve and the injector strainer valve ordinarily used on locomotives. It is operated by a



Franklin Tank and Strainer Valve.

key and is held in an open position by means of a spring; to close the valve the key is turned to the right, this operation closing both ports. In order to clean the strainer the movement of the key is continued to the right until the port from the tank is open and the drain on the opposite side of the screen is also open. In bringing the valve to this position, the screen is reversed so that the flow of water through it is opposite to its normal flow when the valve is in the open position, resulting in a thorough cleansing action on the screen. An indicator is provided from which



Sections Through Franklin Tank and Strainer Valve, Showing Valve Positions.

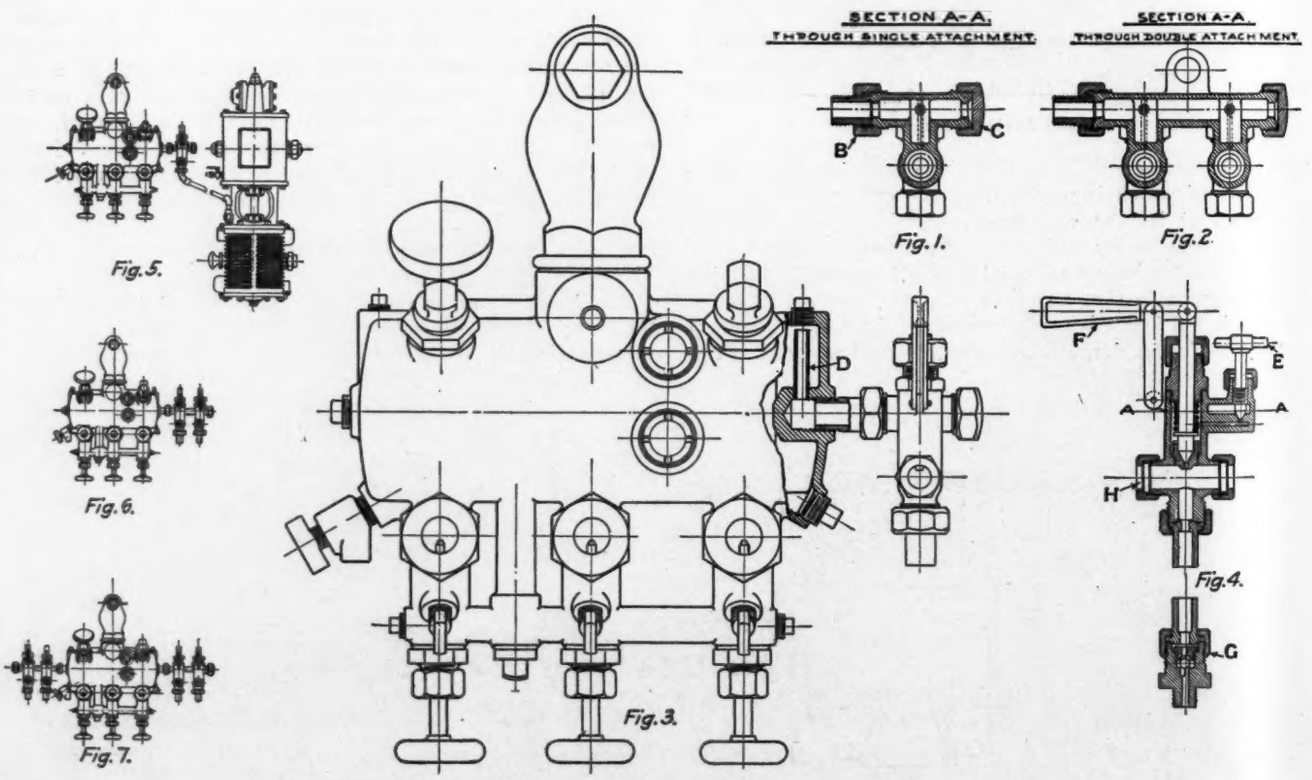
the operating rods extend to the valve, and a dog is placed on this indicator for holding the valve in either the closed or cleaning position. The valve is connected so that it is operated from the outside, making it unnecessary for the operator to go under the tender. It is manufactured by the Franklin Railway Supply Company, New York, and can be used either with the ordinary hose connection, or with the Franklin water joint.

OILING THE AIR CYLINDERS OF AIR PUMPS.

The proper lubrication of the air cylinders of locomotive air pumps is a troublesome problem; very little oil is required, and a surplus causes the cylinder to gum up. Automatic oilers have been tried, and also oiling devices attached directly to the lubricator, but the automatic oilers, as a rule, are very difficult to regulate, and the oilers attached to the lubricators are liable to be left open by the operators and the air cylinder then becomes flooded with oil.

The Nathan Manufacturing Company, New York, has developed a device which, it is claimed, solves this problem in a satisfactory manner. It consists of a chamber connected to the lubricator by means of the union connection *B*, and is so constructed that it may be attached to either side of the lubricator by simply exchanging this connection with the cap *C*. The oil is supplied to the lubricator from the pipe *D*, and the rate of flow is regulated by means of the screw valve *E*. The small passage beneath the valve *E* is filled with oil, and when lubrication of the air cylinder is desired, the operator pulls down the lever *F* for an instant and then lets it go. The valve attached to the lever *F* then closes automatically and it is, therefore, impossible for the operator to leave the valve open and flood the air cylinder with oil. At the point where the usual oiler screws into the top of the air cylinder, a check valve *G* is attached. The arrangement is made either single as shown in Figs. 1 and 4, or double, as shown in Fig. 2. The sight-feed *H* enables the operator to observe the flow of oil. The general arrangement of the attachment is shown in Fig. 5, while Fig. 6 shows a double attachment connected to the right side of the lubricator, and Fig. 7 a double device attached to both sides of the lubricator. It will thus be seen that all possible requirements may be complied with by either a single, one double or two double attachments.

Improved Cast Steel Side Frame.—The Buckeye Steel Castings Company, Columbus, Ohio, has on exhibition a type of cast steel side frame which does away with half the usual number of journal box bolts, and still allows the use of the standard M. C. B. journal box. The two journal box bolts that are used with each truck frame, instead of four, are relieved of much of their work without introducing a special design of journal box or bolt.



Arrangement of Device for Lubricating the Air Cylinders of Air Pumps.